PCE16136

WATER RESOURCES SYSTEMS PLANNING & MANAGEMENT

LECTURE NOTES

Module-IV

Prepared By

Dr. Prakash Chandra Swain

Professor in Civil Engineering

Veer Surendra Sai University of Technology, Burla

Branch - Civil Engineering
Specialization-Water Resources Engineering
Semester – 2th Sem

Department Of Civil Engineering

VSSUT, Burla

Disclaimer

This document does not claim any originality and cannot be used as a substitute for prescribed textbooks. The information presented here is merely a collection by Prof. P.C.Swain with the inputs of Post Graduate students for their respective teaching assignments as an additional tool for the teaching-learning process. Various sources as mentioned at the reference of the document as well as freely available materials from internet were consulted for preparing this document. Further, this document is not intended to be used for commercial purpose and the authors are not accountable for any issues, legal or otherwise, arising out of use of this document. The authors make no representations or warranties with respect to the accuracy or completeness of the contents of this document and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose.

Course content

Module IV

Water Quality Management: Water Quality Objectives and Standards, Water Quality Control Models, Wastewater Transport Systems, River Water Quality Models and Lake Quality models.

Legal Aspects of Water & Environment Systems: Principles of Law applied to Water Rights and Water Allocation, Water Laws, Environmental Protection Law, Environmental Constraints on water Resources Development.

Lecture note 1

Water quality management

1.1 Introduction

Water Quality Management covers the fundamentals of water quality; water quality modelling and systems analysis of streams, reservoirs, and estuaries; and practical water quality topics and problems. The book presents topics on the legal aspects; the physical, chemical, and biological dimensions of water quality; and water quality requirements. The text also describes the pollution inputs from both point and nonpoint sources; eutrophication; thermal pollution; and groundwater quality. Detailed discussions on water quality parameters and characteristics; hydrologic and hydraulic aspects of water quality; mixing; and simple and complex water quality models are also included. The topic further tackles discussion on waste assimilative capacity determination, as well as effluent outfall design. Practicing environmental engineers and professionals involved in pollution abatement programs, environmental students undertaking studies in water quality management, and professionals involved in water quality management or water resources problems will find the text quite.

1.2 Water Quality Objectives and Standards

Water quality maintaining and monitoring has become an important part of sustainable development. The quality problems in water arise mainly due to its molecular structure itself which makes it a universal dissolvent. Usually water quality is expressed as a function of space and time. The quality of water body shows rapid variations. Variations are more in a river, less in lakes and much less in aquifers. In this lecture we will discuss about the concepts of water quality and river water quality modeling.

It is essential for devising water quality management programme to properly use water in any project. It gives information for following decisions to be taken.

- Helps in identifying the present and future problems of water pollution.
- Identifying the present resources of water as per various usages.
- It helps in developing plans and setting priorities for water quality management programme so as to meet future water requirements.
- It helps in evaluating the effectiveness of present management actions being taken and devising future course of actions.

1.2.1 Physical Parameters

The physical tests include the following tests:

Temperature: The temperature of water is measured by means of ordinary thermometers. Density, viscosity, vapour pressure and surface tension of water are all dependent upon the temperature. The saturation values of solids and gases that can be dissolved in water and the rates of chemical, biochemical and biological activity are also determined on the basis of temperature. The temperature of surface water is generally same as the atmospheric temperature while that of ground water may be more or less than atmospheric temperature.

Colour: The colour of water is usually due to presence of organic matter in colloid condition, and due to the presence of mineral and dissolved organic and inorganic impurities. Transparent water with a low accumulation of dissolved materials appears blue. Dissolved organic matter such as humus, peat or decaying plant matter, etc. produce a yellow or brown colour. Some algae or dinoflagellates produce reddish or deep yellow waters. Water rich in phytoplankton and other algae usually appears green. Soil runoff water has a variety of yellow, red, brown and gray colours. The colour in water is not harmful but it is objectionable. The colour of a water sample can be reported as Apparent or True colour. Apparent colour is the colour of the whole water sample and consists of color from both dissolved and suspended components. *True color* is measured after filtering the water sample to remove all suspended material. Before testing the color of the water, first of all total suspended matter should removed from the water by centrifugal force in a special apparatus. After this, the color the water is compared with standard color solution or color discs. When multicolored industrial wastes are involved, such color measurement is meaningless. The color produced by one milligram of platinum in a litre of distilled water has been fixed as the unit of color.

Turbidity: It is caused due to presence of suspended and colloidal matter in the water. Ground waters are generally less turbid than the surface water. The character and amount of turbidity depends on the type of soil over which the water has moved. Turbidity is a measure of the resistance of water to the passage of light through it. Turbidity is expressed in parts per million (ppm or milligrams per litre or mg/1). Earlier, the turbidity produced by one milligram of silica in one litre of distilled water was considered as the unit of turbidity. Turbidity was previously determined by Jackson candle Turbidity units (JTU).

This unit is now replaced by more appropriate unit called Nephelometric Turbidity unit (NTU) which is the turbidity produced by one milligram of formazin polymer in one litre of distilled water. Nephelometry method has better sensitivity, precision and applicability over a wide range of particle size and concentrations as compared to older methods.

Tastes and odors:

Tastes and odors in water are due to the presence of

(i) Dead or living microorganisms;

(ii) Dissolved gases such as hydrogen sulphide, methane, carbon dioxide or oxygen combined with organic matter;

(iii) Mineral substances such as sodium chloride, iron compounds;

(iv) Carbonates and sulphates.

The odor of water also changes with temperature. The odor may be classified as sweetish, vegetable, greasy, etc. The odor of both cold and hot water should be determined. The intensities of the odors are measured in terms of threshold odor number (TON). TON indicates how many dilutions it takes to produce odor-free water. In this method, enough odor free water is added to the flasks containing different amount of sample to create a total volume of 200 mL.

$$TON = \frac{A+B}{A} = \frac{200 \text{ ml}}{\text{Sample volume (mL)}}$$

Where, A is the volume of sample water and B is the volume of odor-free water added to make 200 mL of total water.

Specific conductivity of water:

The total amount of dissolved salts present in water can be estimated by measuring the specific conductivity of water. The specific conductivity of water is determined by means of a portable ionic water tester and is expressed as micro-mho per cm at 25°C. 'mho' is the unit of conductivity and it equals to 1 Ampere per volt. The specific conductivity of water in micro mho per cm at 25°C is multiplied by a coefficient generally 0.65. So as to directly obtain the dissolved salt content in mg/L or ppm. The actual value of this coefficient depends upon the type of salt present in water.

1.3 River Water Quality Modelling

Water quality can be divided into five categories based on the colour of discharge:

Category	Colour	Amount of pollution
I	Blue	No/ Slight
II	Green	Moderate
III	Yellow	Heavy
IV	Red	Excessive
V	Black	Zone of devastation

There are two components for river water quality modeling:

(i) forecasting the developments in the basin and subsequent effects in the water quality and (ii) forecasting of pollution concentration changes within the stream which includes prediction of solute concentration at various points at various times taking solute concentration at specified point as input and finding the dominant processes controlling the solute concentration.

Forecasting of concentration is a simple task if the contaminants are stable i.e., if the concentration changes only through dilution and evaporation. However, precipitation, sedimentation, adsorption etc also act as forcing factors to change the concentrations of many organic and inorganic substances. Such processes are influenced by factors such as pH, temperature, bed characteristics etc, which need to be treated separately.

Pollutants may enter the river through a point source or a non-point source. If the source is a well-defined outlet such as industrial outlet or municipal sewers, then it is termed as a point source. If the source is distributed along the water course such as runoff from land, it is termed as non-point source.

The source of pollutants can also be classified as continuous and instantaneous source. While continuous sources dump pollutants over a long period of time (e.g. municipal waste water plant), instantaneous sources dump pollutants for a very short interval of time (e.g. spill from a tanker). A plot of pollute concentration with respect to time is known as pollutograph. The graph of the product of pollutant concentration and flow rate/time is known as loadograph.

1.4 Components of a river water quality model

The governing dynamic equations of a river water quality model consider various hydrologic, thermal and biochemical processes that take place within the system. These equations are basically conservation of mass, momentum and energy. The biochemical and chemical processes in a river are influenced by hydraulic and thermal conditions. The main influencing hydraulic variables are flow velocity, depth and discharge. An increase in flow velocity decreases the self-purification. However, it also results in increased turbulence, which aids in proper mixing of oxygen and hence increases reaeration. Greater depths block penetration of sunlight, hence slowing down the photosynthetic process. Pollutant concentration is inversely proportional to discharge since an increased discharge increases the dilution rate. River water quality model therefore can be divided into three components: hydraulic, thermal and biochemical submodels.

Hydraulic and thermal models:

Considering one-dimensional unsteady flow, the influencing variables are flow depth and cross-section of flow. The influencing equations are conservation of mass and momentum. Thermal model has only one variable i.e., temperature. This submodel can be skipped by directly inputting the variable to the biochemical model.

Biochemical model:

The real life interactions may lead to a large number of variables, making the model complex. One may reduce the number of variables by substitution or grouping of similar variables. A pertinent indicator of water quality is the dissolved oxygen (DO). BOD represents the amount of oxygen needed for biochemical oxidation of matter in a unit volume of water. Most of the biochemical models are simplified versions of the real processes taking place in the water body.

Geochemical processes

In addition to the physical processes, chemical and biological processes also influence the solute transport. These geochemical reactions can either be homogenous wherein the dissolved species interact with species of same phase (e.g. Hydrolysis) or heterogenous wherein species from different phases are involved (e.g. reaction between dissolved oxygen and atmospheric oxygen).

Sorption

Sorption is an important process which controls the pollute concentration. It is the process in which a dissolved species called sorbate becomes associated with a solid surface called sorbent. Absorption takes place if sorbate penetrate the sorbent. Adsorption occurs when sorbate interacts with surface or intersurface of sorbent.

Pollutant concentration

Concentration C is a measure of the quantity of a constituent and can be expressed as

$$C = M / V$$

Where M is the mass of the constituent and V is the volume of the fluid.

Transport of pollutant in rivers

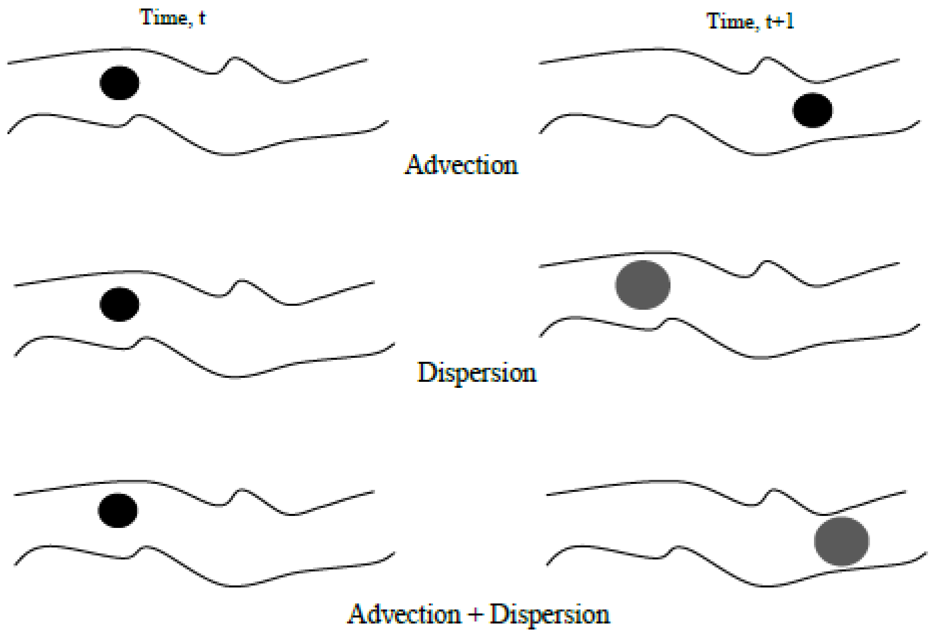
The transport of a constituent is measured in terms of flux. Flux is the rate of flow of mass or energy per unit area normal to the direction of flow. Its unit is quantity per unit area per unit time. The pollutant is transferred through two important mechanisms: advection and dispersion. Advection (or Convection): It is the transfer of a constituent due to the motion of the carrying fluid. The constituent moves with the fluid velocity. Flux F due to advection is the product of velocity U and concentration C, i.e., $F = U\ C$. In advection, the volume of the constituent remains same, while the location changes.

Dispersion: As the constituent moves downstream, the volume increases and the concentration decreases due to mixing up. This is called dispersion. Dispersion can be due to molecular diffusion and velocity variations. In natural streams, the main forcing factor is velocity variations. The flux due to diffusion is given by Flick's law. The flux in the x direction is given by,

$$F_x = E_x \frac{\partial C}{\partial x}$$

Where E_x is the longitudinal dispersion coefficient or diffusivity

The effects of advection and dispersion are shown in figure



(Effects of advection and dispersion)

1.5 Governing Advective – diffusion equation

The basic equation behind the effects of advection and dispersion on solute concentration is the conservation of mass.

Time rate of change of mass = mass inflow – mass outflow.

The one-dimensional form commonly applied in streams is

1.6 River water quality model and lake water quality model

The modeling task is often presented as that of combining deductive and inductive analysis within the framework of the scope of the model. Given the great variability in all these components, it is apparent that every lake and river modeling case is unique.

Figure 1.1 shows a set of questions that are crucial in initiating a modeling procedure. It is useful to extend the discussion on the modeling procedure in somewhat more detail. At this step, we follow the outline by Eykhoff (1974) and Beck (1983). Figure 1.2 summarizes some of the major activities and the various inputs needed for the activities plus the major products of each step.

The procedure above leads to a model structure. It is important to note that the model structure itself contains parameters, but does not yet contain values for them. They are obtained in the model calibration /parameter estimation phase. Why do we actually need parameter estimation? Parameters can roughly be classified to be primarily theoretical or empirical. The former - such as acceleration of gravity or water density - do not need estimation, the latter do. In mechanistic modeling, the parameters are often somewhere in-between those two asymptotes: they are given physical names but they are empirically calibrated or estimated.

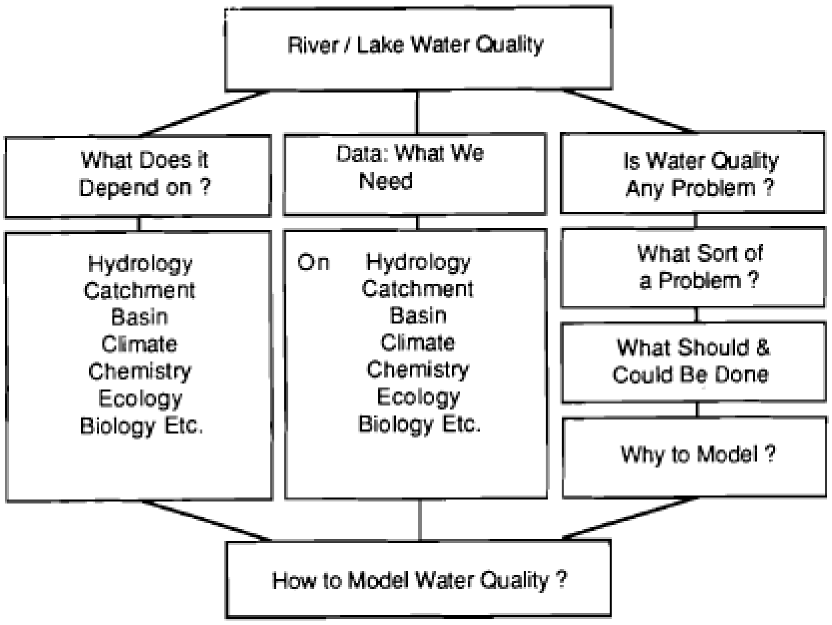


Fig. 1.1 Structure of questions on water quality modeling: Combining deductive and inductive inference within the framework of goals (Varis 1991 b).

One of the major reasons to the high level of empirical parameters in aggregated models is that the model structure postulation not only defines the structure but also the interpretation of parameters. We give two examples on hydrobiology. The aggregation of numerous algal species (each with its own growth rate and light optimum parameters) into one community group leads to new community parameters (community average growth rates and light optimum parameters). The relationship between these new parameters and the original, individual ones, if there exists any in reality, are not at all obvious. In fact, even the structure of the aggregated model may be affected. As another example, nutrient uptake rates of phytoplankton may drop with orders of magnitude when considering the physiological time scale, with time constants around microseconds, to microbiological batch culture rates, from seconds to hours, or to whole-lake simulation / management models, where the time step ranges typically between one day and one week (e.g. Varis 1992 b).

Even if the model structure is derived from the same basic concepts and the parameter has the same label, it does not necessarily mean that the parameter has the same interpretation and a comparable value.

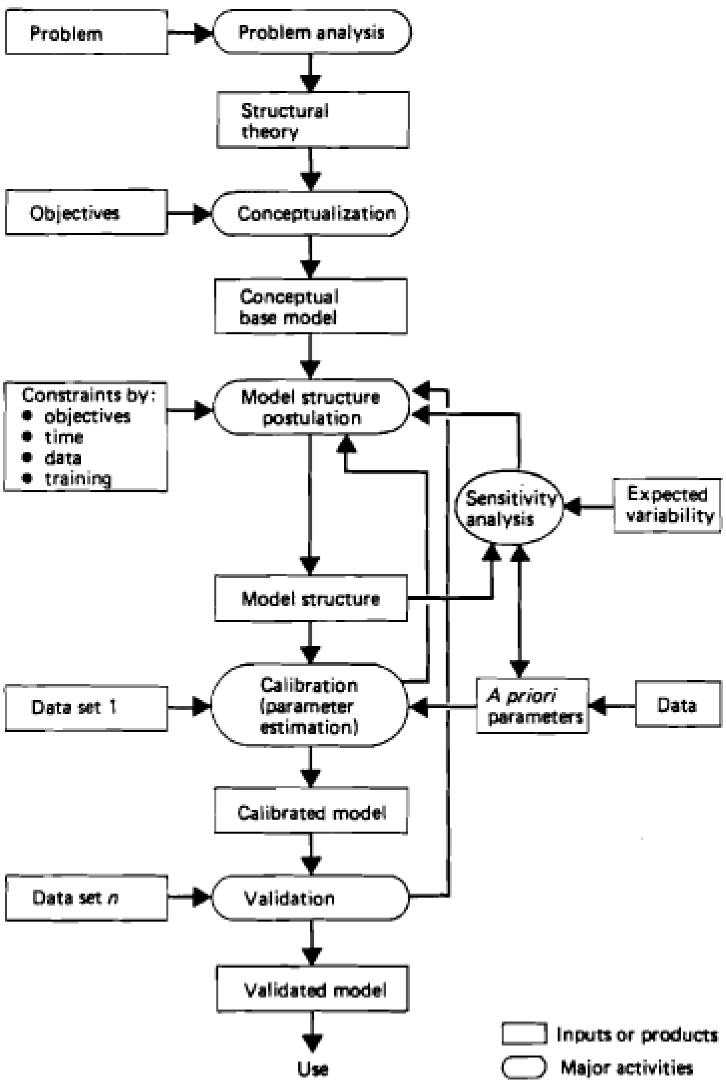


Fig. 1.2 The procedure for model development(van Straten & SomlyWy 1986).

Thus, the most practical approach is to estimate such overall parameters by comparison with field data. It is apparent that the validity of such parameters is restricted to the given model of the system with the given environmental conditions. Of course, ignoring the concept of aggregated parameters with wider applicability would nor be totally correct, but aggregated parameters have a strongly empirical character. Their calibration in a rather ad hoc way has been criticized by e.g. Young (1983), and we admit that there are serious problems. However, owing to the reasons given in introduction, we see good reasons for relying on mechanistic models in appropriate, typically strategic (and sometimes directive) planning cases.

Two aspects that can simplify the task of model calibration must be mentioned. First, sensitivity analysis - an approximative use of partial derivatives of the states with respect to parameters - reveals the parameters to which the model is particularly sensitive, and their sensitive periods, respectively. The calibration procedure can specifically be oriented using this information and, because the model is sensitive, they can usually be reasonably estimated, given a proper model structure. In contrast, it is unlikely that parameters that do not strongly influence the model outcome can be estimated accurately. For such parameters very large confidence bounds appear, in which case it may be better to keep those parameters fixed from the beginning, in case they are not left out of the whole exercise. The inclusion of non-confident, insensitive parameters is debatable and should be avoided unless they are related to future situations and scenarios, which we definitely are not able to validate. Keeping the model as simple as possible has several advantages, the most important of which probably being the fact that the model should be simple to allow its understanding and critique also by other experts. This is, in the Popperian sense, a key to scientific systems analysis (cf. Beck 1987): a scientific analysis should be formulated in a manner in which it can unambiguously be falsified. Sensitivity analyses may also be of good help in design of observations for more exact calibration of the models (see Walter 1982, Godfrey & DiStefano 1987, Kettunen et al. 1989), as well as in more systematic identification of parameter values.

Lecture note 2

Legal Aspects of Water & Environment Systems

2.1 Environmental Acts and Rules

In 1972, a National Council of Environment Planning and Co-ordination was set-up at the Department of Science and Technology. Another committee was set-up in 1980 for reviewing the existing legislations and administrative machinery for environmental protection and for recommending ideas to strengthen the existing laws and environmental agencies in India. In 1980, a separate Department of Environment was set-up which was upgraded to full-fledged Ministry of Environment and Forests in 1985.

Ministry of Environment and Forests (MoEF) of Government of India serves as the nodal agency for the planning, promotion, making of environment laws and their enforcement in India. Following are the other important agencies which help the MoEF in carrying out environment related activities:

- Central Pollution Control Board
- State Pollution Control Boards
- State Departments of Environment
- Union Territories (UT) Environmental Committees
- The Forest Survey of India
- The Wildlife Institute of India
- The National Afforestation and Eco-development Board
- The Botanical and Zoological Survey of India, etc.

2.2 Environmental Laws and Rules

Major environmental laws dealing with protection of environment can be dived into following categories:

A. Water pollution

B. Air pollution

C. Environment protection

D. Public liability insurance

E. National environment appellate authority

F. National environment tribunal

G. Animal welfare

H. Wildlife

I. Forest conservation

J. Biodiversity

K. Indian forest service

Major acts, rules and notifications under each of the above categories are as given below:

A. WATER POLLUTION

i. **Acts**

1. No.36 of 1977, [7/12/1977] - The Water (Prevention and Control of Pollution) Cess Act, 1977, amended 1992.

1. No. 19 of 2003, [17/3/2003] - The Water (Prevention and Control of Pollution) Cess (Amendment) Act, 2003.

2. No.6 of 1974, [23/3/1974] - The Water (Prevention and Control of Pollution) Act, 1974, amended 1988.

ii. **Rules**

1. G.S.R.378(E), [24/7/1978] - The Water (Prevention and Control of Pollution) Cess Rules, 1978.

2. G.S.R.58(E), [27/2/1975] - The Water (Prevention and Control of Pollution) Rules, 1975.

3. Central Board for the Prevention and Control of Water Pollution (Procedure for Transaction of Business) Rules, 1975 amended 1976.

iii. **Notifications**

1. S.O.498(E), [6/5/2003] - Date on which the Water (Prevention and Control of Pollution) Cess (Amendment) Act, 2003 (19 of 2003) came into force.

2. S.O.499(E), [6/5/2003] - Rate of Cess notified under the Water (Prevention and Control of Pollution) Cess (Amendment) Act, 1977(36 of 1977).

B. AIR POLLUTION

i. **Act**

1. No.14 of 1981, [29/3/1981] - The Air (Prevention and Control of Pollution) Act 1981, amended 1987.

ii. **Rules**

1. G.S.R.6(E), [21/12/1983] - The Air (Prevention and Control of Pollution) (Union Territories) Rules, 1983.
2. G.S.R.712(E), [18/11/1982] - The Air (Prevention and Control of Pollution) Rules, 1982.

iii. **Notifications**

1. G.S.R.935(E), [14/10/1998] - Ambient Air Quality Standard for Ammonia (NH3).
2. G.S.R.382(E), [28/3/1988] - The Date on which the Air Amendment Act of 1987 came into force.

C. ENVIRONMENT PROTECTION

i. **Act**

1. No.29 of 1986, [23/5/1986] - The Environment (Protection) Act, 1986, amended 1991.

ii. **Rules**

1. S.O.844(E), [19/11/1986] - The Environment (Protection) Rules, 1986.

1. G.S.R.448(E), [12/07/2004] - The Environment (Protection) Second Amendment Rules, 2004.
2. S.O.470(E), [21/6/1999] - Environment (Siting for Industrial Projects) Rules, 1999.

iii. **Notifications**

1. **Coastal Regulation Zone**

1. S.O.991(E), [26/11/1998] - Constitution of National Coastal Zone Management Authority.

2. **Delegation of Powers**

1. S.O.729(E), [10/7/2002] - Delegation of Powers U/S 20 of E(P) Act, 1986 to CPCB.

3. **Eco-marks Scheme**

1. G.S.R.85(E), [20/2/1991] - The Scheme on Labeling of Environment Friendly Products (ECOMARK).
2. G.S.R.768(E), [24/8/1992] - The criteria for labeling Cosmetics as Environment Friendly Products.

Eco-sensitive Zone

1. S.O.133(E), [4/2/2003] - Matheran and surrounding region as an Ecosensitive Zone.
2. S.O.52(E), [17/1/2001] - Mahabaleswar Panchgani Region as an Ecosensitive region.
3. S.O.825(E), [17/9/1998] - Pachmarhi Region as an Eco-sensitive Zone.
4. S.O.350(E), [13/5/1998] - Order Constituting the Taj Trapezium Zone Pollution (Prevention and Control) Authority.
5. S.O.884(E), [19/12/1996] - Dahanu Taluka Environment Protection Authority, 1996, amended 2001.
6. S.O.481(E), [5/7/1996] - No Development Zone at Numaligarh, East of Kaziranga.
7. S.O.319(E), [7/5/1992] - Restricting certain activities causing Environmental Degradation at Aravalli Range.
8. S.O.416(E), [20/6/1991] - Dahanu Taluka, District Thane (Maharashtra) to declare as Ecologically fragile Area, amended 1999.
9. S.O.102(E), [1/2/1989] - Restricting location of industries, mining & other activities in Doon Valley (UP).
10. S.O.20(E), [6/1/1989] - Prohibiting Industries in Murud-Janjira, Raigadh District, Maharashtra.

6. Environmental Labs

1. S.O.728(E), [21/7/1987] - Recognization of Environmental Laboratories and Analysts.

7. Hazardous Substances Management Rules

1. S.O.432(E), [16/5/2001] - The Batteries (Management and Handling) Rules, 2001.
2. S.O.908(E), [25/9/2000] - The Municipal Solid Wastes (Management and Handling) Rules, 2000.
3. S.O.705(E), [2/9/1999] - The Recycled Plastics Manufacture and Usage Rules, 1999.

1. S.O.698(E), [17/6/2003] - The Recycled Plastics Manufacture and Usage (Amendment) Rules, 2003.

4. S.O.243(E), [26/3/1997] - Prohibition on the handling of Azodyes.
5. G.S.R.347(E), [1/8/1996] - The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996.
6. G.S.R.1037(E), [5/12/1989] - The Rules for the Manufacture, Use, Import, Export and Storage of Hazardous micro-organisms Genetically engineered organisms or cells.

7. S.O.966(E), [27/11/1989] - The Manufacture, Storage and import of Hazardous Chemical Rules, 1989.
8. S.O.594(E), [28/7/1989] - The Hazardous Wastes (Management and Handling) Rules, 1989.
9. S.O.630(E), [20/7/1998] - The Bio-Medical Waste (Management and Handling) Rules, 1998.

Noise Pollution

1. S.O.123(E), [14/2/2000] - Noise Pollution (Regulation and Control) Rules, 2000.
1. S.O.1088(E), [11/10/2002] - The Noise Pollution (Regulation and Control) (Amendment) Rules, 2002.
2. S.O.1046(E), [22/11/2000] - The Noise Pollution (Regulation and Control) (Amendment) Rules, 2000.
2. Rules relating to Noise Pollution notified under Environment (Protection) Rules, 1986 are as under:
1. G.S.R.520(E), [1/07/2003] - The Environment (Protection) Amendment Rules, 2003.
2. G.S.R.849(E), [30/12/2002] - The Environment (Protection) Fourth Amendment Rules, 2002.

Ozone Layer Depletion

1. S.O.670(E), [19/7/2000] - The Ozone Depleting Substances (Regulation and Control) Rules, 2000.

D. PUBLIC LIABILITY INSURANCE

i. Act

1. No.6 of 1991, [22/1/1991] - The Public Liability Insurance Act, 1991, amended 1992.

ii. Rule

1. S.O.330(E), [15/5/l991] - The Public Liability Insurance Rules, 1991, amended 1993.

E. NATIONAL ENVIRONMENT APPELLATE AUTHORITY

i. Act

1. NO.22 of 1997, [26/3/1997] - The National Environment Appellate Authority Act, 1997.

F. NATIONAL ENVIRONMENT TRIBUNAL

i. Act

1. No.27 of 1995, [17/6/1995] - The National Environment Tribunal Act, 1995.

G. ANIMAL WELFARE

i. Act

1. No.59 of 1960 - The Prevention of Cruelty to Animals Act, 1960.

ii. Rules

1. S.O.1256(E), [24/12/2001] - The Animal Birth Control (Dogs) Rules, 2001.

2. S.O.267(E), [26/3/2001] - The Performing Animals (Registration) Rules, 2001.

iii. Notification

1. G.S.R.619(E), [14/10/1998] - The Prevention of Cruelty to Animals (Restricted to Exhibit on Trained as a Performing Animals).

H. WILDLIFE

i. Act

1. No. 16 of 2003, [17/1/2003] - The Wild Life (Protection) Amendment Act, 2002.

2. The Indian Wildlife (Protection) Act, 1972, amended 1993.

ii. Rules

1. S.O.1092(E), [22/9/2003] - The National Board for Wild Life Rules, 2003.

2. S.O.445(E), [18/4/2003] - The Declaration of Wild Life Stock Rules, 2003.

3. G.S.R.350(E), [18/4/1995] - The Wildlife (Specified Plant Stock Declaration) Central Rules, 1995.

iii. Notifications

1. S.O.1093(E), [22/9/2003] - Constitution of the National Board for Wild Life.

2. S.O.1091(E), [22/9/2003] - Coming into force of section 6 of the Wild Life (Protection) Amendment Act, 2002 (16 of 2003).

3. S.O.446(E), [18/4/2003] - Delegation of Powers of section 58E of the Wild Life (Protection) Act, 1972 (53 of 1972).

iv. Guideline

1. Guidelines for Appointment of Honorary Wildlife Wardens.

I. FOREST CONSERVATION

i. Acts

1. Forest (Conservation) Act, 1980, amended 1988.

2. The Indian Forest Act, 1927.

ii. Rules

1. G.S.R.23(E) - Forest (Conservation) Rules, 2003.

2. G.S.R.719 - Forest (Conservation) Rules, 1981, amended 1992.

iii. Guidelines

1. No.5-5/86-FC, [25/11/1994] - Guidelines for diversion of forest lands for nonforest purpose under the Forest (Conservation) Act, 1980.

J. BIODIVERSITY

i. Act

1. NO. 18 of 2003, [5/2/2003] - The Biological Diversity Act, 2002.

i. S.O.753(E), [01/07/2004]- Coming in to force of sextions of the Biodiversity Act, 2002.

ii. S.O.497 (E), [15/04/2004]- Appointment of non-official members on NBA from 1st October, 2003.

iii. S.O.1147 (E)- Establishment of National Biodiversity Authority from 1st October, 2003.

iv. S.O.1146 (E)- Bringing into force Sections 1 and 2; Sections 8 to 17; Sections 48,54,59,62,63,64 and 65 w.e.f. 1st October, 2003.

ii. Rule

1. G.S.R.261 (E), [15/04/2004] - Biological Diversity Rules, 2004.

K. IFS (Indian Forest Service)

i. Rule

1. NO.17011/03/200-IFS-II, [10/2/2001] - Rules for a competitive examination to be held by the UPSC for the IFS.

ii. Notification

1. NO.A.12011/1/94-IFS-I, [14/12/2000] - Scheme for staffing posts included in the Central Deputation Reserve of the Indian Forest Service and other Forestry Posts similar.

2.2 Duties of Indian Citizen

Legislations alone are not the remedy for environmental management, it is the responsibility of all the citizens to strive to protect the environment for the present and future generations since it is the fundamental duty of citizens to protect and conserve the environment as enshrined in our Constitution. Virtually, environmental legislation is essentially a social legislation since environmental degradation affects all of us. The criminal nature of pollution offences have to be viewed seriously. Environmental legislation provides the framework for punitive action against the offenders.

Conservation, recycle, and reuse are the current trends observed in the control of environmental pollution. Even though there may be law regarding these aspects scattered in different Acts of Indian legislation, there is a need for comprehensive Resource Conservation and Recovery Act today. It is not always necessary that Environmental degradation or danger should occur to implement the law. One should always take steps before such happenings.

The problem of environmental degradation is a complex one which requires multidimensional approach. There is dearth of environmental protection laws, but we need a firm hand to implement them. Environmental education can play an important role in negating the adverse impacts of pollution.

2.3 MAJOR ENVIRONMENTAL LAWS

I. THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974

- This act provides for the prevention and control of water pollution and the maintenance or restoration of wholesomeness of water.
- As such, all human activities having a bearing on water quality are covered under this Act.
- Subject to the provisions in the Act, no person without the pervious consent of the State
- Pollution Control Board (SPCB) can establish any industry, operation or any treatment and disposal system or an extension or addition there to which is likely to discharge sewage or trade effluent into a stream or well sewer or on hand and have to apply to the SPCB concerned to obtain the 'consent to establish' as well as the consent to operate' the industry after establishment.

II. THE WATER (PREVENTION AND CONTROL OF POLLUTION) CESS ACT, 1977

- The main purpose of this Act is to levy and collect cess on water consumed by certain categories of industry specified in the schedule appended to the Act.
- The money thus collected is used by CPCB and SPCBs to prevent and control water pollution.

III. THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981

- The objective of the Air Act 1981 is to prevent, control and reduce air pollution including noise pollution.
- Under provisions of this Act, no person shall, without previous consent of the SPCB, establish or operate any industrial plant in air pollution control area the investor has to apply to the SPCB/Pollution Control Committee (PCB) to consent.
- No person operating any industrial plant shall emit any air pollution in excess of the standards laid down by the SPCB and have to comply with the stipulated conditions.

IV. THE ENVIRONMENT (PROTECTION) ACT, 1986

- This is an umbrella Act for the protection and improvement of environment and for matters connected, which provides that no person carrying on any industry, operation or process should discharge or emit or permit to discharged or emitted any environmental pollutant in excess of such standards as may be prescribed.

- Several rules relative to various aspects of management of hazardous chemicals, wastes, etc. have been notified. Under this Act, Central Govt. has rusticated, prohibited location of industries in different areas so as to safeguard the environment.
- Many standards for air emissions, discharge of effluent and noise have been evolved and notified.
- Subject to the provision of this Act, Central Govt. has the power to take all measures as it deemed necessary for the purpose of protection and improving the environment.
- Procedures, safeguards, prohibition and restriction on the handling of hazardous substances along with the prohibition and restriction on the location of industries in different areas have notified.

V. THE HAZARDOUS WASTES (MANAGEMENT AND HANDLING) RULES, 1989 & 2000.

- Hazardous wastes have been categories in 18 categories.
- Under this rule, project proponent handling hazardous waste must report to the concerned authorities regarding handling of wastes, obtain authorization for handling wastes, maintain proper records, file annual returns, label all packages, consignments etc., report any accident immediately in for report import-export of hazardous waste.
- MOEF notified the HW (M&H) Amendment Rules in January 6, 2000 (MOEF, 2000a). Under this rule, toxic chemicals, flammable chemicals and explosive have been redefined to be termed as ‘hazardous chemical’. As per new criteria, 684 hazardous chemicals.

VI. THE MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES, 1989 & 2000.

- Under these rules, project proponents of any kind of hazardous industry have to identify likely hazard and their anger potential. They also have to take adequate steps to prevent and limit the consequences of any accident at site.

- Material safety Data Sheets (MSDS) for all the chemicals in handling has to be prepared. Workers on site are required to be provided with information, training and necessary equipment to ensure their safety.
- Onsite Emergency Plan is to be prepared before initiating any activity at the site. Off-site Emergency Plan is to be prepared by the District Controller in close collaboration with the project proponents for any accident envisaged on site.
- The public in the vicinity of the plant should be informed of the nature major accident that may occur on site and Do's and Don'ts to be followed in case of such an occurrence.
- Import of hazardous chemicals is to be reported to the concerned authority within 30 days from the data of import.
- MOEF made significant amendments in the MSIHC Rules, 1989 on January 20, 2000. Under new amendments, new schedule –I is incorporated with the increase in the number of hazardous chemicals.
- Renewal of authorization will be subject to submission of 'Annual Returns' for disposal of hazardous waste; reduction in the waste generated or recycled or reused; fulfillment of authorization conditions and remittance processing and analysis fee.
- State government as well as occupier or its association shall be responsible for the identification site for common waste disposal facility. Public hearing is also made mandatory to be conducted by the state government before notifying any common hazardous waste disposal site.
- Central/State government will provide guidance for the design, operation and closure of common waste facility/landfill site. It is mandatory to obtain prior approval from the SPCB for design and layout the proposed hazardous waste disposal facility.

VII. PUBLIC LIABILITY INSURANCE ACT, 1991.

- This Act, unique to India, on the owner the liability to immediate relief in respect of death or to any person or damage to any property resulting from an accident while handling hazardous any of the notified hazardous chemicals.
- This relief has to be provided on 'no fault' basis.
- The owner handling hazardous chemical has to take an insurance policy to meet this

liability of an amount equal to its "Paid up capital" or up to Rs. 500 millions, whichever less. The policy has to be renewed every year.

- New undertaking will have to take this policy before starting their activity. The owner also has to pay an amount equal to its annual premium to the Central Government's Environment Chief Fund (ERF). The reimbursement of medical expenses up to Rs. 12,500/-. The liability of the insurance is tied to Rs. 50 million per accident up to Rs. 150 million per year or up to the tenure of the policy.
- Any claims process to this liability will be paid from the ERF. In case the award still exceeds, the remaining amount shall have to be met by the owner.
- The payment under the Act is only for the immediate relief; owners shall have to provide the compensation if any, arising out of legal proceeding.

References:

1. Loucks, D.P., Stedinger, J.R. and Haith, D.A. (1982) “Water Resources Systems Planning and Analysis”, Prentice Hall Inc. N York

2. Chaturvedi, M.C. (1987), “Water Resources Systems Planning and Management”, Tata McGraw Hill Pub. Co., N Delhi.

3. Hall. W.A. and Dracup, J.A. (1975), “Water Resources Systems”, Tata McGraw Hill Pub. N Delhi

4. James, L.D. and Lee (1975), “Economics of Water Resources Planning”, McGraw Hill Inc. n York

5. Kuiper, E. (1973) “Water Resources Development, Planning, Engineering and Economics”, Buttersworth, London

6. Biswas, A.K. (1976) “Systems Approach to Water Management”, McGraw Hill Inc. N York

7. Taha H A, (1996), “Operations Research”, Prentice Hall of India, N Delhi.