

Module 1: INTRODUCTION

Lecture	Topic	No. of Hours (10)
1	Introduction to Environmental Engineering	1
2	Environmental Acts and Rules	1
3	Standards for Ambient Air, Noise Emission and Effluents	1
4	Water Quality Monitoring: Collection of Water Samples & Estimation of Physical Parameters	1
5	Water Quality Monitoring: Estimation of Chemical Parameters	1
6	Water Quality Monitoring: Estimation of Alkalinity, BOD & COD	1
7	Water Quality Monitoring: Estimation of Fecal Indicator Bacteria	1
8	Characterization of Air Emissions	1
9	Fugitive Emission Control and Water Use Minimization	1
10	Water Recycling and Reuse	1

Lecture 1

Introduction to Environmental Engineering

MAIN OBJECTIVES OF THE COURSE

- To develop interest among Chemical Engineers regarding environment and its protection.
- To provide basic understanding of environmental engineering so that the Chemical Engineers may meet the expectation of the Industries for pollution control in their premises so as to comply with newer and tougher laws and acts that are being enforced in India and globally.
- To introduce the principles and methods to control air, water and soil pollution to the undergraduate students of chemical engineering.
- To develop basic understanding of following topics:
 - sources of water, air and land pollution
 - recycle and reuse of waste, energy recovery and waste utilization
 - air pollution and its measurement
 - design of pollution abatement systems for particulate matter and gaseous constituents
 - design of waste-water and industrial effluent treatment
 - hazardous waste treatment and disposal
 - solid-waste disposal and recovery of useful products.

ENVIRONMENTAL ENGINEERING

- According to Peavy et al. [1], it is that branch of engineering that is concerned with protecting the environment from the potentially deleterious effects of human activity, protecting human populations from the effects of adverse environmental actors and improving environmental quality for human health and well being [2].
- Environmental engineering is still an evolving branch of engineering that is closely related to Chemical and Civil engineering.
- It is closely associated with chemistry, physics and biology; and has elements of hydrology, meteorology, atmospheric sciences, environmental chemistry, microbiology and ecology.

ENVIRONMENTAL ETHICS AND EIA

- Traditionally, industries and its basic components were designed based upon technical and economic considerations only. Now-a-days, it is essential to consider environment, health and safety as factors during design [3].
- Environmental ethics is related to attitude of people towards other living beings and environment [4].
- During any project, though it is essential that ‘economic sustainability’ is attained; however, it is also essential that ‘ecological sustainability’ and ‘social sustainability’ are also attained.
- Impact assessment is a handy tool to assess the environmental compatibility of the projects in terms of their location, suitability of technology, efficiency in resources utilization and recycling, etc.
- Environmental Impact Assessment (EIA) has now been made a prerequisite for the settling up of new projects and renewal of licenses of old and existing plants.
- EIA is a major instrument in decision making and for measurement of sustainability in the context of the regional carrying capacity. It provides the conceptual framework for extending the cumulative assessment of development policies, plans and projects on a regional basis.
- Sustainable development of chemical process industries is a process in which the exploitation of resources and the direction of the investments are all made consistent with future as well as present heads.

POLLUTION DUE TO CHEMICAL PROCESS INDUSTRIES

The primary causes of industrial pollution are [5]:

- Use of outdated and inefficient technologies for product manufacturing, pollution abatement and various other operation in industries which generate a large amount of wastes
- Development of unplanned industrial conglomerations without foreseeing the effect on environment
- The existence of large number of small scale industries without defining land use patterns and environmental regulations for them
- Poor enforcement of pollution control laws for big and small industries

Major polluting industrial sectors

- | | | |
|----------------------|--------------------------------|--------------------|
| 1) Cement | 2) Thermal power plants | 3) Iron & Steel |
| 4) Fertilizer | 5) Zinc Smelters | 6) Copper Smelters |
| 7) Aluminum Smelters | 8) Oil Refineries | 9) Distilleries |
| 10) Pulp & Paper | 11) Dyes and Dye Intermediates | 12) Pesticides |
| 13) Petro Chemicals | 14) Petroleum refining | 15) Sugar |
| 16) Tanneries | 17) Basic Drugs | |

Major Concerns of Industrial Pollution [6]

- Water and air pollution from chemical process industries need immediate attention.
- Industrial wastewaters vary widely in their composition and treatment methods, which have to take in to consideration the specific characteristic of the wastes.
- Many treatment practices have followed the approach of mixing the liquid sewage waste with industrial waste and treating the mixture by conventional methods.
- Treatment methods such as lagoon (aerobic & anaerobic), oxidation ditches and aerated lagoons have also been tried with varying degree of success. The majority of treatment plants have, however, failed to succeed. The chief reasons for this have been the omission of some of the key parameters that govern biological oxidation when industrial wastes are treated.
- Physico-chemical methods are necessary to remove or recover the chemical ingredients present in liquid effluents discharged from electroplating, chlor-alkali, pesticides, fertilizers, dyes and pigments, metallurgical, paper and pulp, etc. and other such process industries.
- The reuse of water in processes where the water quality standards are not stringent is worth considering. A considerable quantity of water is presently being reused in process industries in India but a lot more needs to be done in this area.

MAJOR DEFINITIONS AS PER INDIAN ENVIRONMENTAL ACTS [7]

- “**Environment**” includes water, air and land and the inter-relationship which exists among and between water, air and land and human beings, other living creatures, plants, micro-organism and property.
- “**Environmental pollutant**” means any solid, liquid or gaseous substance present in such concentration and may be, or tend to be, injurious to environment.
- “**Air pollutants**” means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human being or other living creatures or plants or property or environment.
- “**Air pollution**” means the presence in the atmosphere of any air pollutant
- “**Ambient air**” means that portion of the atmosphere, external to buildings, to which the general public has access.

ENVIRONMENTAL CRISIS DUE TO INDUSTRIAL DEVELOPMENT

- Large scale contamination of water and air.
- Deforestation
- Increase in urban slums
- Generation of huge solid waste consisting of hazardous material.
- Water scarcity and ground water depletion.
- Global warming
- Greenhouse effect
- Ozone layer depletion

LIST OF PROJECTS OR ACTIVITIES REQUIRING PRIOR ENVIRONMENTAL CLEARANCE [8]

Table 1.1.1. Mining, extraction of natural resources and power generation (for a specified production capacity)

Sl. No.	Project or Activity	Category with threshold limit		Conditions if any
		A	B	
1(a)	Mining of minerals	<p>≥ 50 ha. of mining lease area</p> <p>Asbestos mining irrespective of mining area</p>	<p><50 ha</p> <p>≥ 5 ha .of mining lease area.</p>	<p>General Condition shall apply</p> <p><u>Note</u> Mineral prospecting (not involving drilling) are exempted provided the concession areas have got previous</p>

				clearance for physical survey
1(b)	Offshore and onshore oil and gas exploration, development & production	All projects		<u>Note</u> Exploration Surveys (not involving drilling) are exempted provided the concession areas have got previous clearance for physical survey
1(c)	River Valley projects	(i) ≥ 50 MW hydroelectric power generation; (ii) $\geq 10,000$ ha. of culturable command area	(i) < 50 MW ≥ 25 MW hydroelectric power generation; (ii) $< 10,000$ ha. of culturable command area	General Condition shall apply
1(d)	Thermal Power Plants	≥ 500 MW (coal/lignite/naphtha & gas based); ≥ 50 MW (Pet coke diesel and all other fuels)	< 500 MW (coal/lignite/naphtha & gas based); < 50 MW ≥ 5 MW (Pet coke ,diesel and all other fuels)	General Condition shall apply
1(e)	Nuclear power projects and processing of nuclear fuel	All projects	-	

Table 1.1.2. Primary Processing

Sl. No.	Project or Activity	Category with threshold limit		Conditions if any
		A	B	
2(a)	Coal washeries	≥ 1 million ton/annum throughput of coal	< 1 million ton/annum throughput of coal	General Condition shall apply (If located within mining area the proposal shall be appraised together with the mining proposal)
2(b)	Mineral beneficiation	≥ 0.1 million ton/annum mineral throughput	< 0.1 million ton/annum mineral throughput	General Condition shall apply (Mining proposal with Mineral beneficiation shall be appraised together for grant of clearance)

Table 1.1.3. Materials Production

Sl. No.	Project or Activity	Category with threshold limit		Conditions if any
		A	B	

3(a)	Metallurgical industries (ferrous & non ferrous)	a) Primary metallurgical industry All projects b) Sponge iron manufacturing ≥ 200TPD c) Secondary metallurgical processing industry All toxic and heavy metal producing units ≥ 20,000 tonne/annum -	Sponge iron manufacturing <200TPD Secondary metallurgical processing industry i.) All toxic and heavy metal producing units <20,000 tonne/annum ii.) All other non-toxic secondary metallurgical processing industries >5000 tonne/annum	General Conditions shall apply for Sponge iron manufacturing
3(b)	Cement plants	≥ 1.0 million tonne/annum production capacity	<1.0 million tonne/annum production capacity. All Stand alone grinding units	General Conditions shall apply

Table 1.1.4. Materials Processing

Sl. No.	Project or Activity	Category with threshold limit		Conditions if any
		A	B	
4(a)	Petroleum refining industry	All projects	-	-
4(b)	Coke oven plants	≥2,50,000 tonne/annum -	<2,50,000 & ≥25,000 tonne/annum	-
4(c)	Asbestos milling and asbestos based products	All projects	-	-
4(d)	Chlor-alkali industry	≥300 TPD production capacity or a unit located out side the notified industrial area/ estate	<300 TPD production capacity and located within a notified industrial area/ estate	Specific Condition shall apply No new Mercury Cell based plants will be permitted and existing units converting to membrane cell technology are exempted from this Notification
4(e)	Soda ash Industry	All projects	-	-
4(f)	Leather/skin/hide processing industry	New projects outside the industrial area or expansion of existing units out side the industrial area	All new or expansion of projects located within a notified industrial area/ estate	Specific condition shall apply

Table 1.1.5. Manufacturing/Fabrication

Sl. No.	Project or Activity	Category with threshold limit		Conditions if any
		A	B	
5(a)	Chemical fertilizers	All projects	-	-
5(b)	Pesticides industry	All units producing	-	-

	and pesticide specific intermediates (excluding formulations)	technical grade pesticides		
5(e)	Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)	All projects -	-	
5(d)	Manmade fibres manufacturing	Rayon	Others	General Condition shall apply
5(e)	Petrochemical based processing (processes other than cracking & reformation and not covered under the complexes)	Located outside the notified industrial area/ estate -	Located in a notified industrial area/ estate	Specific Condition shall apply
5(f)	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	Located outside the notified industrial area/ estate	Located in a notified industrial area/ estate	Specific Condition shall apply
5(g)	Distilleries	(i) All Molasses based distilleries (ii) All Cane juice/ non-molasses based distilleries ≥ 30 KLD	All Cane juice/non-molasses based distilleries - < 30 KLD	General Condition shall apply
5(h)	Integrated paint industry	-	All projects	General Condition shall apply
5(i)	Pulp & paper industry excluding manufacturing of paper from waste paper and manufacture of paper from ready pulp without bleaching	Pulp manufacturing and Pulp & Paper manufacturing industry -	Paper manufacturing industry without pulp manufacturing	General Condition shall apply
5(j)	Sugar Industry	- -	≥ 5000 tcd cane crushing capacity	General Condition shall apply
5(k)	Induction/arc	-	All projects	General Condition

	furnaces/cupola furnaces 5TPH or more	-		shall apply
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Table 1.1.6. Service Sectors

Sl. No.	Project or Activity	Category with threshold limit		Conditions if any
		A	B	
6(a)	Oil & gas transportation pipe line (crude and refinery/ petrochemical products), passing through national parks/sanctuaries/coral reefs/ecologically sensitive areas including LNG Terminal	All projects	-	-
6(b)	Isolated storage & handling of hazardous chemicals (As per threshold planning quantity indicated in column 3 of schedule 2 & 3 of MSIHC Rules 1989 amended 2000)	-	All projects	General Condition shall apply

Table 1.1.7. Physical Infrastructure including Environmental Services

Sl. No.	Project or Activity	Category with threshold limit		Conditions if any
		A	B	
7(a)	Air ports	All projects		-
7(b)	All ship breaking yards including ship breaking units	All projects	-	-
7(c)	Industrial estates/parks/ complexes/ areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes.	If at least one industry in the proposed industrial estate falls under the Category A, entire industrial area shall be treated as Category A, irrespective of the area. Industrial estates with area greater than 500 ha. and housing at least one Category B industry.	-Industrial estates housing at least one Category B industry and area <500 ha. Industrial estates of area > 500 ha. and not housing any industry belonging to Category A or B.	Special condition shall apply Note: Industrial Estate of area below 500 ha. and not housing any industry of category A or B does not require clearance.
7(d)	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	All integrated facilities having incineration & landfill or incineration alone	All facilities having land fill only	General Condition shall apply
7(e)	Ports, Harbours	≥ 5 million TPA of cargo handling capacity (excluding fishing harbours)	< 5 million TPA of cargo handling capacity and/or ports/ harbours ≥10,000 TPA of fish handling capacity	General Condition shall apply
7(f)	Highways	i) New National High ways; and	i) New State High ways; and	General Condition shall apply

		ii) Expansion of National High ways greater than 30 KM, involving additional right of way greater than 20m involving land acquisition and passing through more than one State.	ii) Expansion of National/ State Highways greater than 30 km involving additional right of way greater than 20m involving land acquisition.	
7(g)	Aerial ropeway		All projects	General Condition shall apply
7(h)	Common Effluent Treatment Plants (CETPs)		All projects	General Condition shall apply
7(i)	Common Municipal Solid Waste Management Facility (CMSWMF)		All projects	General Condition shall apply

Table 1.1.8. Building/Construction projects/Area Development projects and Townships

Sl. No.	Project or Activity	Category with threshold limit		Conditions if any
		A	B	
8(a)	Building and Construction projects		$\geq 20000 \text{ m}^2$ and $< 1,50,000 \text{ m}^2$ of built-up area#	#(built up area for covered construction; in the case of facilities open to the sky, it will be the activity area)
8(b)	Townships and Area Development projects.		Covering an area $\geq 50 \text{ ha}$ and or built up area $\geq 1,50,000 \text{ m}^2$ ++	++All projects under Item 8(b) shall be appraised as Category B1

Note:-

General Condition (GC): Any project or activity specified in Category 'B' will be treated as Category A, if located in whole or in part within 10 km from the boundary of: (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified Eco-sensitive areas, (iv) inter-State boundaries and international boundaries.

Specific Condition (SC): If any Industrial Estate/Complex/ Export processing Zones/Special Economic Zones/Biotech Parks/ Leather Complex with homogeneous type of industries such as Items 4(d), 4(f), 5(e), 5(f), or those Industrial estates with pre –defined set of activities (not necessarily homogeneous, obtains prior environmental clearance, individual industries including proposed industrial housing within such estates/complexes will not be required to take prior environmental clearance, so long as the Terms and Conditions for the industrial estate/complex are complied with (Such estates/complexes must have a clearly identified management with the legal responsibility of ensuring adherence to the Terms and Conditions of prior environmental clearance, who may be held responsible for violation of the same throughout the life of the complex/estate).

REFERENCES

[1] Peavy, H. S., Rowe, D. R., Tchobanoglous, G. "Environmental Engineering", McGraw-Hill, 1985.

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- [5] <http://wmc.nic.in/chapter2-environmentalscenario.asp>.
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- [8] MoEF-EIA, Notification on EIA under sub-rule (3) of Rule 5 of the Environment (Protection) Rules, 1986, Published on 14th September, 2006 <http://moef.nic.in/legis/eia/so1533.pdf>.