SREENIVASA INSTITUTE OF TECHNOLOGY AND *MANAGEMENT STUDIES (SITAMS)*
AUTONOMOUS – NBA ACCREDITED (CSE, ECE & EEE)
(Approved by AICTE, New Delhi & Affiliated to JNTUA, Ananthapuramu)
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SUBJECT NAME: INDUSTRIAL WASTE TREATMENT AND DISPOSAL(20OCIV472)

Regulation: R20

UNIT –I

INTRODUCTION

INDUSTRY

An industry is a group of businesses or factories that make similar products or offer similar services.

Industries Use:

- **Raw materials** (like cotton, iron, oil)
- **Workers and machines**
- **Energy and technology**

And they produce:

- **Goods** (like clothes, cars, food)
- **Services** (like banking, transport, IT)

Types of Industries and Their Pollution

Industries are businesses that produce goods or services. Different types of industries cause different kinds of pollution. Let's look at the main ones:

1. Manufacturing Industry

- **What it does:** Makes products like clothes, furniture, electronics, etc.
- **Pollution caused:**
  - **Air pollution:** Smoke and gases from factories
  - **Water pollution:** Dirty water with chemicals
  - **Noise pollution:** Loud machines

2. Chemical Industry

- **What it does:** Produces chemicals, plastics, fertilizers, and drugs
- **Pollution caused:**
  - **Air pollution:** Toxic gases and bad smells
  - **Water pollution:** Harmful chemicals in rivers
  - **Soil pollution:** Dangerous waste dumped in the ground

3. Textile Industry

- **What it does:** Makes fabrics and clothing
- **Pollution caused:**
  - **Water pollution:** Coloured dyes and detergents in water
  - **Air pollution:** Dust and fumes from processing

4. Mining Industry

- **What it does:** Digs up minerals like coal, gold, and iron
- **Pollution caused:**
  - **Air pollution:** Dust and harmful gases
  - **Water pollution:** Poisonous chemicals in streams
  - **Soil pollution:** Destruction of land
  - **Noise pollution:** Explosions and machines

5. Oil and Petroleum Industry

- **What it does:** Extracts and refines oil and gas
- **Pollution caused:**

- **Air pollution:** Greenhouse gases and fumes
- **Water pollution:** Oil spills
- **Soil pollution:** Leaks and chemical waste

6. Paper and Pulp Industry

- **What it does:** Makes paper products
- **Pollution caused:**
  - **Water pollution:** Chemicals used to bleach paper
  - **Air pollution:** Smoke and gases

7. Power Industry (like coal power plants)

- **What it does:** Produces electricity
- **Pollution caused:**
  - **Air pollution:** Carbon dioxide, smoke, and ash
  - **Thermal pollution:** Hot water dumped into rivers
  - **Soil pollution:** Ash and waste

8. Food Processing Industry **What it does:** Processes raw food into packaged food

- **Pollution caused:**
  - **Water pollution:** Wastewater from cleaning and cooking
  - **Air pollution:** Odors and gases

9. Construction Industry **What it does:** Builds roads, buildings, bridges, etc.

- **Pollution caused:**
  - **Air pollution:** Dust from cement and sand
  - **Noise pollution:** Heavy machinery sounds
  - **Soil pollution:** Debris and construction waste

10. Electronics Industry

- **What it does:** Makes phones, computers, appliances
- **Pollution caused:**
  - **Soil pollution:** E-waste and heavy metals
  - **Air pollution:** Toxic fumes during production
  - **Water pollution:** Chemical waste

Types of Pollution

Pollution Type	What It Is	Examples
Air Pollution	Dirty air from smoke, gas, dust	Factory smoke, car exhaust
Water Pollution	Dirty water with chemicals or waste	Factory discharge, oil spill
Soil Pollution	Harmful materials in the ground	Industrial waste, pesticides
Noise Pollution	Too much loud sound	Machinery, construction
Thermal Pollution	Hot water dumped into rivers	Power plants
Radioactive Pollution	Radiation from nuclear waste	Nuclear plants, medical waste

CAUSES OF INDUSTRIAL POLLUTION

Lack of Policies to Control Pollution

1. Lack of effective policies and poor enforcement drive allowed many industries to bypass laws made by pollution control board.
2. It resulted in mass scale pollution that affected lives of many people.

Unplanned Industrial Growth

1. In most industrial townships, unplanned growth took place wherein those companies flouted rules and norms and polluted the environment with both air and water pollution.

Use of Outdated Technologies

1. Most industries still rely on old technologies to produce products that generate large amount of waste.
2. To avoid high cost and expenditure, many companies still make use of traditional technologies to produce high end products.

Presence of Large Number of Small-Scale Industries

1. Many small scale industries and factories that don't have enough capital and rely on government grants to run their day-to-day businesses often escape environment regulations
2. It releases large amount of toxic gases in the atmosphere.

Inefficient Waste Disposal

1. Water pollution and soil pollution are often caused directly due to inefficiency in disposal of waste.
2. Long term exposure to polluted air and water causes chronic health problems,

making the issue of industrial pollution into a severe one.

3. It also lowers the air quality in surrounding areas which causes many respiratory disorders.

Leaching of Resources from Our Natural World

1. Industries do require large amount of raw material to make them into finished products.
2. This requires extraction of minerals from beneath the earth.
3. The extracted minerals can cause soil pollution when spilled on the earth.
4. Leaks from vessels can cause oil spills that may prove harmful for marine life.

EFFECTS OF INDUSTRIAL POLLUTION ON HUMAN HEALTH

1. It causes irritation of eye, nose, throat respiratory tracts, etc.
2. It increases mortality rate and morbidity rate.
3. A variety of particulates mainly pollens, initiate asthmatic attacks.
4. Chronic pulmonary diseases like bronchitis and asthma are aggravated by high concentration of SOz, NOT, particulate matter and photo-chemical smog.
5. Certain heavy metals like lead may enter the body through lungs and cause poisoning.

On animal health

1. In case of animals, the pollutants enter in two steps.
2. Accumulations of the airborne contaminants in the vegetation forage and prey animals.
3. Subsequent poisoning of the animals when they eat the contaminated food.
4. In case of animals, three pollutants namely fluorine, arsenic and lead are responsible for most livestock damage.

On plants

1. Industrial pollution has been shown to have serious adverse effects on plants.
2. In some cases, it is found that vegetation over 150 Km. away from the source of pollutants have been found to be affected.
3. The major pollutants affecting plants are SOA, O,, MO, NO2, NHS, HCN, Ethylene, Herbicides, PAN (Peroxyl Acetyl nitrate) etc.
4. In the presence of pollutants, the healthy plants suffer from neurosis, chlorosis, abscission, epinasty etc.

Control of Industrial Pollution Control at Source:

1. It involves suitable alterations in the choice of raw materials and process in treatment of exhaust gases before finally discharged.
2. Increasing stock height up to 38 meters in order to ensure proper mixing of the discharged pollutants.

Selection of Industry Site

1. The industrial site should be properly examined considering the climatic and topographical characteristics before setting of the industry.

Treatment of Industrial Waste

1. The industrial wastes should be subjected to proper treatment before their discharge. Plantation
   Intensive plantation in the region considerably reduces the dust, smoke and other pollutants.

Stringent Government Action:

Government should take stringent action against industries which discharge
higher amount of pollutants into the environment than the level prescribed by Pollution Control Board.

CHARACTERISTICS OF INDUSTRIAL WASTES

The purposes of pollution control endeavours should be

1. To protect the assimilative capacity of surface waters.
2. To protect shellfish, finfish and wildlife.
3. To preserve or restore the aesthetic and recreational value of surface waters.
4. To protect humans from adverse water quality conditions.

The selection and design of treatment facilities is based on a study of

1. The physical, chemical and biological characteristics of the wastewater.
2. The quality that must be maintained in the environment to which the wastewater is to be discharged or for the reuse of the wastewater.
3. The applicable environmental standards or discharge requirements that must be met.
4. The main chemical characteristics of wastewater are divided into two classes, inorganic and organic.

Physical characteristics

1. The principal physical characteristics of wastewater are its solids content, colour, odour and temperature.
2. The total solids in a wastewater consist of the insoluble or suspended solids andthe soluble compounds dissolved in water.
3. Volatile solids are presumed to be organic matter, although some organic matter will not Burnand some inorganic salts break down at high temperatures.
4. The organic matter consists mainly of proteins, carbohydrates and fats.
5. Solids may be classified in another Wayas well those that are volatilized at a high temperature(600“C) and those that are not.
6. The former are known as volatile solids, the latter as fixed solids.
7. Usually, volatile solids are organic.
8. Colour is a qualitative characteristic that can be used to assess the general condition of wastewater.
9. If the colour is dark grey or black, the wastewater is typically septic, having undergone extensive bacterial decomposition under anaerobic conditions.
10. The blackening of wastewater is often due to the formation of various sulphide, particularly, ferrous sulphide.
11. The determination of odour has become increasingly important.
12. The odour of fresh wastewater is usually not offensive, but a variety of odorous compounds are released when wastewater is decomposed biologically under anaerobic conditions.
13. The principal odorous compound is hydrogen sulphide (the smell of rotten eggs).
14. The temperature of wastewater is commonly higher than that of the water supply because warm municipal water has been added.
15. The temperature of wastewater will vary from season to season and also with geographic location.

Chemical characteristics Inorganic chemicals

1. The principal chemical tests include free ammonia, organic nitrogen, nitrites,nitrates, organic phosphorus and inorganic phosphorus.
2. Nitrogen and phosphorus are important because these two nutrients are responsible for the growth of aquatic plants.
3. Trace elements, which include some heavy metals, are not determined routinely, but trace elements may be a factor in the biological treatment of wastewater.
4. All living organisms require varying amounts of some trace elements, such as iron, copper, zinc and cobalt, for proper growth.

Organic chemicals

1. The tests may be divided into those used to measure gross concentrations of organic matter greater than about 1 mg/1.
2. Laboratory methods commonly used today to measure gross amounts of organic matter (greater than 1 mg/1) in wastewater include
    i. Biochemical oxygen demand (BOD)
    ii. Chemical oxygen demand (COD)
    iii. Total organic carbon (TOC).

Organic pollutants

1. Effluent from industrial sources contains a wide variety of pollutants, including organic pollutants.
2. Primary and secondary sewage treatment processes remove some of these pollutants, particularly oxygen-demanding substances, oi1, grease and solids.
3. Others, such as refractory (degradation- resistant) organics (organochlorides, nitro compounds etc.) and salts and heavy metals, are not efficiently removed.
4. Soaps, detergents and associated chemicals are potential sources of organic pollutants.
5. Water contaminated with these compounds must be treated using physical and chemical methods, including air stripping, solvent extraction, ozonation and carbon adsorption.

POPULATION **EQUIVALENT** AND BIOASSAY **STUDIES**

Population equivalent

Population equivalent or unit per capita loading, (PE), in waste-water treatment is the number expressing the ratio of the sum of the pollution load produced during 24 hours by industrial facilities and services to the individual pollution load in household sewage produced by one person in the same time.

Population equivalents of wastewater from some industries

Type	Activity	BOD PE [inhabit/(unit/d)]
Food	Canning (fruit/vegetables)	500
	Pea processing	85-400
	Tomato	50-155
	Carrot	160-390
	Potato	215-545
	Citrus fruit	55
	Chicken meat	70-1600
	Fish	300-2300
	Sweets/candies	40-150
	Sugar cane	50
	Dairy (without cheese)	20-100

TRENDS IN BIOASSAY USE FOR EFFLUENT MANAGEMENT BIOASSAYS AND WASTEVWATER QUALITY

Main conclusions

1. A broad range of micropollutants and their effects were eliminated by more than 80% after the advanced treatments.
2. There was no evidence for a toxicity increase due to a constant formation of stable toxic ozonation by-products.
3. An ozonation should be followed by a final filtration step with biological activity.
4. Quality of treated effluent was significantly improved, leading to improved surface water quality.

Evaluation of Bioassays and Wastewater Quality Project Strategy Micro poll

1. The aim of the project “Strategy Micro poll” of the Swiss Federal Office for the Environment **(FOEN)** was to develop a strategy regarding micro pollutants originating from municipal wastewater.
2. A situation analysis was conducted in order to assess the contamination of Swiss surface waters with micro pollutants
3. Possibilities for financing measures for advanced wastewater treatment were evaluated. In order to evaluate possible technical treatments to reduce the concentrations and effects of organic micro pollutants in surface waters, two large-scale pilot studies were conducted.
4. In both studies the efficiency of complementary wastewater treatment for elimination of micropollutants from wastewater treatment effluent was assessed, such as ozonation followed by sand filtration (ozonation-SF) and different processes including powdered activated carbon addition (PAC).
5. Technical aspects as well as a performance review regarding the elimination of micropollutants using chemical measurements and ecotoxicological test systems were included.

Approach of bio-assay

1. A broad range of biotests for the evaluation of water and wastewater quality is available.
2. An important goal of this project was to identify appropriate bioassays sensitive enough to detect the effects of micro pollutants.
3. The selection of eco toxicological test systems was based on preliminary studies conducted before the first pilot study by measuring specific cello far effects, as well as integrative tests with whole organisms group on ecotoxicology.
4. Bioassays were selected based on one or more of the following selection criteria.
    - Test sensitivity is Standardized test methods are available.
    - Consideration of different trophic levels (bacteria, algae, macrophytes, invertebrates, vertebrates)
5. Application of different types of sample processing and test systems:

- Assessment of enriched wastewater samples
- High enough to detect contaminant effects in treated wastewater in the

- Assessment of wastewater samples without sample enrichment
- Effect measurements with organisms in flow-through systems (channels,
- microcosms)

6. Two types of bioassays were used:
    - *In vitro* bioassays based on specific cellular mechanisms measure cellular effects specific to groups of toxicants with similar modes of action.
    - These assays use cell cultures or transgenic bacteria or yeast to detect changes in receptor activation or enzyme function. endocrine, genotoxic or mutagenic effects; or inhibition of signal transduction.
7. They integrate the effects of all substances in a wastewater sample such as chemicals, nutrients etc., but, depending on the used assays they give none or only limited information about the causative substance classes or relevant molecular processes.

Performance Analysis of Advanced Wastewater Treatment Toxicity Parameters

1. Biological parameters measured in bioassays, such as mortality, number of offspring, cell number, weight, and cellular receptor activity, are commonly referred to as 'endpoints'.
2. The term 'toxicity parameter' refers to effect values, which are calculated using statistical or mathematical methods.
3. The calculation is done by regression analysis and gives, additionally to the respective derived toxicity parameter, a confidence interval
4. **NOEC** The no observed effect concentration (NOEC) is the highest tested concentration that does not yet because a statistically significant effect compared to the control.
5. **LOEC** The lowest observed effect concentration (LOEC) is the lowest tested concentration that elicits a statistically significant effect compared to the control.
6. **TEQ** The toxic equivalent concentration (TEQ) is defined as the concentration of reference substance, which would have the same effect as the environmental sample.