Energy and Environment Engineering

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ENVIRONMENT AND ECOSYSTEMS

Introduction: Concept of an ecosystem- structure and functions of ecosystem. Components of ecosystem - producers, consumers, decomposers, Food chains, food webs, ecological pyramids, Energy flow in ecosystem. Bio-geo- chemical cycles, Hydrologic cycle Components of Environment and their relationship, Impact of technology on environment, Environmental degradation. Environmental planning of urban network services such as water supply, sewerage, solid waste management.

ENVIRONMENTAL POLLUTION

Water, air, soil, noise, thermal and radioactive, marine pollution: sources, effects and engineering control strategies. Drinking water quality and standards, Ambient air and noise quality standards

GLOBAL ENVIRONMENTAL ISSUES AND ITS MANAGEMENT

Engineering aspects of climate change. Acid rain, depletion of ozone layer. Concept of carbon credit. Concepts of Environmental impact assessment and Environmental audit. Environmental life cycle assessment

Impact of Technology on Environment

Introduction

- The term ‘technology’ refers to the application of scientific knowledge for practical purposes and the machinery and devices developed as a result.
- We are currently living in a period of rapid change, where technological developments are revolutionising.
- At the same time as leading us further into the depths of catastrophe in the form of climate change and resource scarcity.
- The impact of this technology on the environment has included the misuse and damage of our natural earth.
- Despite the negative impact of technology on environment, a recent rise in global concern for climate change has led to the development of new environmental technology aiming to help solve some of the biggest environmental concerns that we face as a society through a shift towards a more sustainable, low-carbon economy.
- Environmental technology is also known as ‘green’ or ‘clean’ technology and refers to the development of new technologies which aim to conserve, monitor or reduce the negative impact of technology on the environment and the consumption of resources.

Different types of technology

- Air Pollution Control Equipment
- Sewage treatment
- Soil pollution
- Noise Pollution

Air Pollution Control Equipment

- Removes Volatile Organic Compounds (VOCs) and Hazardous Air Pollutants (HAPs) from the air, like sulfuric gases, fumes, odours and vapours.
- VOCs and HAPs pose a threat to the environment, local ecosystems and human health.
- Petroleum, energy production, coal and metal mining, chemical, and waste management industries are a few of the big-league players that have played a considerable role in polluting the environment.
- The Environmental Protection Agency (EPA) implemented the Clean Air Act (CAA) which imposed regulations on both sources of air pollutants to help mitigate their effect on the atmosphere, the environment, and human life.

The goals of industrial air pollution control equipment are to:

1) Decrease the release of harmful gases and control the spread of air and water pollution

2) Conserve whatsoever natural resources are available for our future generations

3) Decrease health threats posed by breathed in and otherwise consumed pollution

- In addition, non-industrial air pollution control equipment is used in households and vehicles.
- In vehicles, precision filtration systems reduce emissions coming out engines, exhaust pipes and air conditioning systems.

How It Works

- Air pollution control equipment may work in one of three different ways:
  1. Chemical modification
  2. Contaminant Destruction
  3. Hazard Removal

Types

- Continuous Emissions Monitoring Systems (CEMS)
- Parametric Monitoring
- Emission Control Systems
- Oxidizer

- Some types of air pollution control equipment applied to industrial applications and which utilize one or more of the methods of air pollutant removal or reduction mentioned above include:
  - Scrubbers
  - Air Filters
  - Cyclones
  - Electrostatic Precipitators
  - Mist Collectors
  - Incinerators
  - Catalytic Reactors
  - Biofilters

Pollution Control Systems — Selection Considerations

Type of Control Equipment	Types of Pollutants Removed	Examples of Pollutants
Dry Scrubbers	Gaseous compounds	•E.g., sulfur dioxide, hydrofluoric acid, hydrochloric acid, etc
Wet Scrubbers	Gaseous compounds; PM	•Water-soluble compounds, VOCs, Vapor
HEPA Filters	PM ≥ 0.3 µm	•Bio-contaminants, Fungi, Pollen, Smoke
Fabric Filters (Baghouses)	PM	•Dust, Fine powders, Abrasives, Metals
Cartridge Dust Collectors	PM	•Dust, Smoke, Fumes
Cyclones	PM ≥ 10–20 µm	•Dust, Ash, Fragments of material
Electrostatic Precipitators	PM	•Dust, Smoke, Fumes (for wet ESPs)
Mist Collectors	Gaseous compounds	•Vapor, Mist, Smoke, Acid gas •E.g., oil, water, etc.

Filtration Efficiencies per Air Pollution Control Equipment

Type of Control Equipment	Control Efficiency
Scrubbers	
Dry Scrubbers	Up to 99% (depending on gas compound); e.g., 50% for mercury; 95% for sulfur dioxide
Wet Scrubbers	70–99% (for gas, depending on equip. model and gas compound) 99% (for PM, depending on equip. model and particulate size)
Air Filters	
HEPA Filters	99.97% (for particulates ≥0.3 µm in diameter)
Fabric Filters (Baghouses)	99.99% (even for fine particulates)
Cartridge Dust Collectors	99.99+%
Cyclones	90% (for particulates ≥10–20 µm in diameter)
Electrostatic Precipitators	99+% (for particulates ≥1.0 µm in diameter)
Mist Collectors	99.9% (for droplets ≥0.3 µm in diameter)
Incinerators	
Thermal Oxidizers	99.99% (for VOCs, 99.99+%)
Catalytic Oxidizers	99.99%
Catalytic Reactors	90+% (for NO_x), 99.99% (for other gaseous pollutants)
Biofilters	98+%

Treatment Technologies for Contaminated Soil

- ❑ Physical/Chemical Treatment
  - Soil Vapour Extraction
  - Solidification/Stabilization
  - Chemical Oxidation
  - Soil Flushing
  - Electro-kinetic Separation
- ❑ Biological Treatment
  - Bioventing
  - Phytoremediation
  - Monitored Natural Attenuation
- ❑ Thermal Treatment
  - Electrical Resistance Heating
  - Steam Injection and Extraction
  - Conductive Heating
  - Radio-Frequency Heating
  - In Situ Vitrification

Water pollution

- Water pollution is the contamination of water bodies such as lakes, rivers, oceans, and groundwater, usually due to human activities.
- Some of the most common water pollutants are domestic waste, industrial effluents and insecticides and pesticides.
- A specific example is the release of inadequately treated wastewater into natural water bodies, which can lead to degradation of aquatic ecosystems.
- Other detrimental effects include diseases such as typhoid and cholera, eutrophication and the destruction of ecosystems which negatively affects the food chain.

Techniques for reducing pollution in wastewater discharges

- Large-scale wastewater treatment is typically carried out by municipalities, sanitary districts, industries, commercial enterprises and various pollution control commissions.
- The purpose here is to describe contemporary methods of municipal wastewater treatment and then to provide some insights regarding treatment of industrial wastes and more advanced methods.
- In general, all processes of wastewater treatment may be grouped into physical, chemical or biological types, and one or more of these may be employed to achieve a desired effluent product.

General classification of wastewater treatment operations and processes

Physical Operations	Chemical Processes	Biological Processes
❑ Flow measurement	❑ Precipitation	❑ Aerobic action
❑ Screening/grit removal	❑ Neutralization	❑ Anaerobic action
❑ Mixing	❑ Adsorption	❑ Aerobic-anaerobic
❑ Flocculation	❑ Disinfection	❑ combinations
❑ Sedimentation	❑ Chemical oxidation	
❑ Flotation	❑ Chemical reduction	
❑ Filtration	❑ Incineration	
❑ Drying	❑ Ion exchange	
❑ Distillation	❑ Electrodialysis	
❑ Centrifuging		
❑ Freezing		
❑ Reverse osmosis		

Industrial wastewater treatment

- Industrial (non-domestic) wastes are numerous and vary greatly in composition.
- Specialized treatment may be necessary to render them innocuous before discharge. Toxicity is of great concern in the disposal of industrial wastewaters.
- Industrial wastes include: pulp and paper, slaughterhouse, brewery, tannery, food processing, chemical, meat and poultry, hog feeding, rendering and many others.
- Soluble organics causing depletion of dissolved oxygen
- Suspended solids
- Trace organics
- Heavy metals, cyanide and toxic organics
- Colour and turbidity
- Nitrogen and phosphorus
- Refractory substances resistant to biodegradation
- Oil and floating material
- Volatile materials.

Treatment methods

- The handling of industrial wastes is more specialized than the treatment of domestic wastes; however, where amenable to biological reduction, they are usually treated using methods similar to those previously described (secondary/tertiary biological treatment approaches) for municipal systems.

Advanced methods of wastewater treatment

- Filtration (sand and multimedia)
- Chemical precipitation
- Distillation
- Nitrification
- Algae harvesting
- Ammonia stripping
- Reverse osmosis
- Ion exchange
- Land application
- Wetlands.

Thank You