

SUBJECT: - ENERGY & ENVIRONMENT

SEMESTER -1 QUESTION BANK – UNIT 4

UNIT IV Advanced Materials for Sustainable Development

QUE.1). Define

i) non-renewable energy source

ii) Industrial Pollution

iii) Noise Pollution

iv) Eutrophication

v) Algal bloom

vi) Acid rain

vii) Global warming

Ans: i) Non-renewable energy source: Non-renewable energy sources are resources that are finite and cannot be replenished in a relatively short period. These energy sources include fossil fuels like coal, oil, and natural gas that are formed over millions of years and are non-renewable in our lifetimes. Non-renewable energy sources are not sustainable and contribute to environmental problems such as air pollution, water pollution, and climate change.

ii) Industrial Pollution: Industrial pollution refers to the contamination of the environment by industrial activities, including manufacturing, mining, and construction. It results in the release of harmful substances into the air, water, and soil, causing harm to human health and the natural ecosystem. Industrial pollution can also contribute to climate change and global warming.

iii) Noise Pollution: Noise pollution is the excessive and unwanted sound that disrupts the normal functioning of life. It can be caused by various sources, including transportation, construction, industrial activities, and loud music. Prolonged exposure to noise pollution can lead to hearing loss, stress, sleep disturbances, and other health issues.

iv) Eutrophication: Eutrophication is the process by which a body of water becomes enriched with nutrients, leading to excessive growth of plant life such as algae. This occurs when excessive amounts of nutrients, usually from human activities such as farming or sewage discharge, enter a body of water. Eutrophication can have harmful effects on aquatic ecosystems, including oxygen depletion, fish kills, and the formation of toxic algal blooms.

v) Algal bloom: An algal bloom is a rapid increase or accumulation of algae in a body of water. This can occur due to eutrophication or other factors such as warm temperatures, stagnant water, or excessive sunlight. Algal blooms can have negative impacts on the ecosystem, including oxygen depletion, fish kills, and the production of harmful toxins that can be dangerous to humans and animals.

vi) Acid rain: Acid rain is a type of precipitation that is more acidic than normal rainwater. It is caused by the release of sulfur dioxide and nitrogen oxide gases into the atmosphere, which react with water and other chemicals to form acids. Acid rain can harm plants, animals, and infrastructure and can contribute to the acidification of soils and bodies of water.

vii) Global warming: Global warming refers to the long-term increase in Earth's average surface temperature, primarily caused by the release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide into the atmosphere. Global warming has significant impacts on the environment and human society, including rising sea levels, more frequent and severe weather events, and changes in ecosystems and agriculture.

QUE.2). How fossil fuel contributes towards industrial pollution?

Ans: Fossil fuels are a major source of industrial pollution. Industrial processes, such as manufacturing, transportation, and energy production, rely heavily on fossil fuels such as coal, oil, and natural gas. When these fuels are burned to generate energy or power industrial processes, they release harmful pollutants into the air, water, and soil.

The combustion of fossil fuels releases a range of pollutants into the atmosphere, including carbon dioxide, sulfur dioxide, nitrogen oxides, and particulate matter. These pollutants can cause a range of health problems, including respiratory diseases, heart disease, and cancer. They can also contribute to the formation of smog and acid rain, which can harm plant and animal life and damage buildings and other infrastructure.

In addition to air pollution, fossil fuel extraction and processing can also lead to water and soil pollution. For example, mining for coal or oil can release heavy metals and other pollutants into water sources. Oil spills from drilling rigs or tankers can also cause significant damage to marine ecosystems, including killing wildlife and damaging habitats.

QUE.3). Describe the factors responsible for the Industrial pollution?

Ans: Industrial pollution is caused by a variety of factors, including:

1. **Industrial processes:** The processes used in various industries, such as manufacturing, mining, and transportation, can release a range of pollutants into the environment, including air, water, and soil. This can include the release of chemicals, metals, and other harmful substances.
2. **Fossil fuel combustion:** The combustion of fossil fuels, including coal, oil, and natural gas, is a major source of air pollution. Burning these fuels releases greenhouse gases and other pollutants into the atmosphere, contributing to climate change and other environmental problems.
3. **Waste disposal:** Improper disposal of industrial waste can lead to pollution of water sources and soil. Chemical waste, heavy metals, and other hazardous materials can contaminate the environment and harm wildlife and human health.
4. **Agricultural activities:** Agricultural activities, such as the use of pesticides and fertilizers, can lead to pollution of water sources and soil. Excessive use of these chemicals can result in eutrophication, algal blooms, and other harmful effects on aquatic ecosystems.
5. **Transportation:** The transportation of goods and people can also contribute to industrial pollution. Vehicle emissions, including particulate matter and nitrogen oxides, contribute to air pollution and can harm human health.
6. **Deforestation:** Deforestation for industrial purposes can lead to soil erosion and loss of habitat for wildlife. It can also contribute to climate change by reducing the amount of carbon that is naturally absorbed by trees.
7. **Lack of regulation and enforcement:** In some cases, a lack of regulation and enforcement can contribute to industrial pollution. Inadequate waste management practices and lack of monitoring can allow pollutants to be released into the environment without consequence.

QUE.4). Classify the major types of Industrial Pollution.

Ans: The major types of industrial pollution can be classified into the following categories:

1. **Air pollution:** Air pollution is caused by the release of harmful chemicals, gases, and particulate matter into the atmosphere by industrial processes. This includes emissions from factories, power plants, and transportation. Examples of air pollutants include sulfur dioxide, nitrogen oxides, carbon monoxide, and particulate matter.
2. **Water pollution:** Water pollution is caused by the release of harmful chemicals and other pollutants into water sources by industrial processes. This includes discharges from factories and mines, as well as agricultural runoff. Examples of water pollutants include heavy metals, pesticides, and organic compounds.
3. **Soil pollution:** Soil pollution is caused by the release of harmful chemicals and other pollutants into the soil by industrial processes. This includes the disposal of industrial waste and the release of contaminants from

mining and agricultural activities. Examples of soil pollutants include heavy metals, pesticides, and petroleum products.

4. Noise pollution: Noise pollution is caused by excessive noise levels generated by industrial processes, such as factories and transportation. This can have negative impacts on human health and wildlife.
5. Thermal pollution: Thermal pollution is caused by the release of heated water into water sources by industrial processes. This can have negative impacts on aquatic ecosystems and wildlife.
6. Light pollution: Light pollution is caused by excessive artificial lighting from industrial processes, such as factories and outdoor lighting. This can have negative impacts on human health and wildlife.

QUE.5). Enlist the rules and regulatory requirements for petroleum industry in India.

Ans: The petroleum industry in India is governed by a number of rules and regulatory requirements to ensure safe and responsible operations. Some of these rules and requirements include:

1. Petroleum and Natural Gas Regulatory Board (PNGRB) Act, 2006: This act established the PNGRB, which is responsible for regulating the refining, processing, storage, transportation, distribution, marketing, and sale of petroleum products.
2. Petroleum Act, 1934: This act provides for the control of production, supply, and distribution of petroleum and petroleum products.
3. Oil Industry (Development) Act, 1974: This act provides for the development of the oil industry in India and the establishment of the Oil Industry Development Board.
4. Environmental regulations: The petroleum industry in India is subject to a number of environmental regulations, including the Air (Prevention and Control of Pollution) Act, 1981, the Water (Prevention and Control of Pollution) Act, 1974, and the Hazardous Waste (Management, Handling, and Transboundary Movement) Rules, 2016.
5. Safety regulations: The petroleum industry is also subject to a number of safety regulations, including the Petroleum Rules, 2002, which prescribe safety standards for storage, handling, and transportation of petroleum products.
6. Licensing and permit requirements: The petroleum industry in India is required to obtain various licenses and permits, including exploration and production licenses, refinery licenses, and marketing licenses.
7. Quality control: The Bureau of Indian Standards (BIS) sets quality standards for petroleum products in India, which are enforced through the BIS Act, 1986.

QUE.6). Enlist the pollutants released by cement industry. Correlate it with each step of manufacturing process.

Ans: The cement industry is a significant source of air pollution, releasing a range of pollutants during the manufacturing process. The pollutants released can be correlated with each step of the manufacturing process as follows:

1. Quarrying and crushing of raw materials: The first step in cement manufacturing is the extraction of raw materials from quarries, followed by crushing and grinding. This process generates dust and particulate matter, which can contain heavy metals such as cadmium, lead, and mercury.
2. Raw material preparation: The crushed and ground raw materials are then mixed with water to form a slurry. This process generates dust and particulate matter.

3. Clinker production: The slurry is then heated in a kiln to produce clinker, which is a granular material composed of calcium oxide and other compounds. This process releases carbon dioxide (CO₂), nitrogen oxides (NO_x), and sulfur dioxide (SO₂) into the atmosphere. It also generates dust and particulate matter.
4. Cement grinding and storage: The clinker is ground into a fine powder and mixed with gypsum to produce cement. This process generates dust and particulate matter.

The pollutants released by the cement industry during each step of the manufacturing process include:

1. Particulate matter (PM): Generated during quarrying, crushing, raw material preparation, clinker production, cement grinding, and storage.
2. Carbon dioxide (CO₂): Released during clinker production due to the combustion of fossil fuels.
3. Nitrogen oxides (NO_x): Released during clinker production due to high-temperature combustion of fossil fuels.
4. Sulfur dioxide (SO₂): Released during clinker production due to the presence of sulfur-containing compounds in raw materials and fossil fuels.
5. Heavy metals: Generated during quarrying and crushing of raw materials, which can contain heavy metals such as cadmium, lead, and mercury.

QUE.7). Describe the alternative way of sulphuric acid synthesis with lesser pollution.

Ans: Sulfuric acid is a widely used industrial chemical that is typically produced by the contact process, which involves the combustion of sulfur dioxide (SO₂) and the subsequent conversion of the SO₂ to sulfur trioxide (SO₃) through catalytic oxidation. While the contact process is efficient, it can also be a significant source of air pollution due to the emissions of SO₂ and other pollutants. An alternative way of sulfuric acid synthesis with lesser pollution is the wet sulfuric acid process or the double absorption process.

The wet sulfuric acid process involves the following steps:

1. Sulfur dioxide is scrubbed from flue gases using a wet scrubber, typically with a solution of sodium hydroxide (NaOH) or calcium carbonate (CaCO₃).
2. The scrubbed SO₂ is then reacted with oxygen (O₂) in the presence of a catalyst to form sulfur trioxide (SO₃).
3. The SO₃ is then absorbed in a second scrubber containing a solution of sulfuric acid (H₂SO₄), forming oleum (H₂S₂O₇).
4. The oleum is then diluted with water to form concentrated sulfuric acid (H₂SO₄).

This process has several advantages over the contact process:

1. Reduced emissions: Since the SO₂ is scrubbed from the flue gases before combustion, there are significantly fewer emissions of SO₂ and other pollutants.
2. Energy efficiency: The wet sulfuric acid process is more energy-efficient than the contact process, as it does not require the heating and cooling of large volumes of gases.
3. Lower capital costs: The wet sulfuric acid process requires less capital investment than the contact process, as it does not require the construction of large combustion chambers and gas cleaning equipment.

QUE.8). Describe the alternative way of ammonia synthesis with lesser pollution.

Ans: Ammonia is an important industrial chemical used in the production of fertilizers, explosives, and various other products. The traditional method of ammonia synthesis involves the Haber-Bosch process, which combines nitrogen

and hydrogen at high pressure and temperature over a catalyst to form ammonia. While this process is efficient, it also consumes a significant amount of energy and generates greenhouse gas emissions. Therefore, there is growing interest in developing alternative ways of ammonia synthesis that are more environmentally friendly. One such alternative is the electrochemical synthesis of ammonia.

The electrochemical synthesis of ammonia involves the following steps:

1. Nitrogen gas is reduced to ammonia using electrons provided by an external electrical source.
2. The nitrogen reduction reaction occurs at the cathode, which is typically made of a metal or carbon material.
3. A proton-conducting membrane separates the cathode and anode compartments and prevents the oxidation of ammonia to nitrogen.
4. The hydrogen required for the reaction is generated at the anode by splitting water into hydrogen ions (protons) and oxygen gas through electrolysis.

The electrochemical synthesis of ammonia has several advantages over the Haber-Bosch process:

1. **Reduced energy consumption:** The electrochemical process does not require high pressure and temperature, which significantly reduces the energy required for ammonia synthesis.
2. **Lower greenhouse gas emissions:** The electrochemical process does not require fossil fuels, which reduces greenhouse gas emissions.
3. **Scalability:** The electrochemical process can be easily scaled up or down depending on the demand for ammonia.

QUE.9). Write short notes on:

i) Nitrification

ii) Eutrophication

iii) Green Ammonia Synthesis

iv) Blue and Green Hydrogen

v) Geber's synthesis of sulphuric acid production

vi) Air pollution due to nitrogen containing manufacturing process

Ans: i) Nitrification: Nitrification is a natural biological process that occurs in soil and water, in which ammonia (NH_3) is converted into nitrite (NO_2^-) and then into nitrate (NO_3^-) by bacteria. This process is important for the nitrogen cycle, as it converts ammonia from organic matter and fertilizers into forms that can be absorbed by plants. However, excessive nitrification can lead to eutrophication, a process in which high levels of nutrients, particularly nitrogen and phosphorus, cause rapid growth of algae and other aquatic plants, leading to depletion of oxygen and other harmful effects on aquatic life.

ii) Eutrophication: Eutrophication is a natural process that occurs when bodies of water, such as lakes and rivers, become enriched with nutrients, particularly nitrogen and phosphorus. This enrichment can be caused by natural sources, such as weathering and erosion, or by human activities, such as agricultural runoff and wastewater discharge. Eutrophication can lead to the growth of algae and other aquatic plants, which can deplete oxygen levels and create dead zones where aquatic life cannot survive.

iii) Green Ammonia Synthesis: Green ammonia synthesis is an alternative method for producing ammonia that uses renewable energy sources, such as wind or solar power, to generate hydrogen, which is then combined with nitrogen to form ammonia. This process reduces greenhouse gas emissions and reliance on fossil fuels, making it a more sustainable and environmentally friendly method of ammonia production.

iv) Blue and Green Hydrogen: Blue and green hydrogen are terms used to describe different methods of producing hydrogen that are more environmentally friendly than traditional methods. Blue hydrogen is produced from natural gas using carbon capture and storage (CCS) technology to capture and store carbon dioxide emissions. Green

hydrogen is produced from renewable energy sources, such as wind or solar power, using electrolysis to separate hydrogen from water. Both blue and green hydrogen offer potential solutions for reducing greenhouse gas emissions from the energy sector.

v) Geber's Synthesis of Sulfuric Acid Production: Geber's synthesis is a method of producing sulfuric acid that was developed by the alchemist Jabir ibn Hayyan, also known as Geber, in the 8th century. The process involves heating iron sulfate (FeSO_4) with charcoal to produce sulfur dioxide (SO_2) and iron oxide (FeO). The sulfur dioxide is then reacted with water and nitrate to form sulfuric acid (H_2SO_4). Geber's synthesis was an important early method for sulfuric acid production and paved the way for modern industrial methods, such as the contact process.

vi) Air Pollution due to Nitrogen Containing Manufacturing Process: Many manufacturing processes, such as the production of fertilizers, plastics, and explosives, involve the use of nitrogen-containing compounds, such as ammonia and nitrogen oxides. These compounds can be released into the air during manufacturing and can contribute to air pollution, including smog and acid rain. In addition, nitrogen oxides can contribute to the formation of ground-level ozone, a harmful air pollutant. Therefore, it is important for industries to take measures to reduce emissions of nitrogen-containing compounds and improve air quality.

QUE.10). What are Nitrogenous fertilizers? State the impact of Nitrogenous fertilizers on environment. Devise a possible solution.

Ans: Nitrogenous fertilizers are fertilizers that contain nitrogen in the form of ammonia (NH_3), nitrate (NO_3^-), or urea. These fertilizers are commonly used in agriculture to increase crop yield, as nitrogen is an essential nutrient for plant growth.

However, the excessive use of nitrogenous fertilizers can have negative impacts on the environment. When nitrogenous fertilizers are applied to soil, some of the nitrogen is absorbed by plants, while the rest can leach into groundwater or runoff into nearby bodies of water. When nitrogen reaches bodies of water, it can contribute to eutrophication, a process in which excessive nutrient levels cause rapid growth of algae and other aquatic plants, leading to oxygen depletion and other harmful effects on aquatic life.

In addition, the production of nitrogenous fertilizers requires a significant amount of energy and contributes to greenhouse gas emissions, which contribute to climate change.

One possible solution to the negative impacts of nitrogenous fertilizers is to adopt more sustainable agricultural practices, such as crop rotation, cover cropping, and integrated pest management. These practices can reduce the need for nitrogenous fertilizers by improving soil health and promoting natural nutrient cycling. In addition, the use of precision agriculture technologies, such as soil sensors and variable rate application systems, can help farmers more precisely apply nitrogenous fertilizers, reducing waste and minimizing environmental impacts. Another solution is the development and use of alternative fertilizers, such as organic and slow-release fertilizers, that release nutrients more slowly and have fewer environmental impacts than traditional nitrogenous fertilizers.

QUE.11). Explain the various sources of pollution in Ammonia plant. Describe the basics of Green Ammonia Synthesis.

Ans: The production of ammonia involves several sources of pollution, including:

1. Air pollution: Ammonia plants emit various air pollutants, such as nitrogen oxides (NO_x), sulfur dioxide (SO_2), and particulate matter (PM), during the combustion of fuels and in the synthesis process itself.
2. Water pollution: The production of ammonia requires a large amount of water, which can become contaminated with ammonia and other chemicals during the manufacturing process. In addition, wastewater from ammonia plants may contain high levels of pollutants, such as nitrogen compounds and heavy metals.

3. Waste and by-product disposal: The production of ammonia generates large quantities of waste and by-products, such as spent catalysts, which can pose environmental risks if not properly disposed of.

Green ammonia synthesis is a process that uses renewable energy sources, such as wind or solar power, to produce ammonia without emitting greenhouse gases or other pollutants. This process involves the following steps:

1. Electrolysis of water: Water is split into hydrogen (H_2) and oxygen (O_2) using an electrolysis process that is powered by renewable energy sources.
2. Nitrogen fixation: Atmospheric nitrogen (N_2) is fixed using a renewable energy source to create nitrogen gas (N_2).
3. Haber-Bosch process: The hydrogen gas and nitrogen gas are combined using the Haber-Bosch process to produce ammonia (NH_3), which can be used as a fertilizer or in other industrial applications.

Green ammonia synthesis has the potential to significantly reduce the environmental impacts of ammonia production by using renewable energy sources and avoiding the emissions of greenhouse gases and other pollutants associated with traditional ammonia production methods. However, the process is still in the early stages of development and faces several technical and economic challenges that must be overcome to become a commercially viable alternative to traditional ammonia production.

QUE.12). Summarize how pollution due to nitrogenous fertilizer manufacturing units can be controlled.

Ans: Pollution from nitrogenous fertilizer manufacturing units can be controlled through various measures, such as:

1. Improving manufacturing processes: Upgrading manufacturing technologies and adopting cleaner production methods can help reduce pollution and minimize waste generation.
2. Implementing pollution control equipment: Installing pollution control equipment such as scrubbers, filters, and electrostatic precipitators can reduce air emissions and particulate matter.
3. Reducing energy consumption: Reducing energy consumption through measures such as energy-efficient technologies and renewable energy sources can help reduce greenhouse gas emissions.
4. Recycling and reuse: Recycling and reusing waste products and by-products can help reduce the amount of waste generated by manufacturing units and minimize their environmental impact.
5. Implementing regulatory standards: Governments can implement strict regulatory standards to limit pollution from manufacturing units, such as emissions standards, waste disposal regulations, and environmental permits.
6. Promoting sustainable agricultural practices: Encouraging farmers to adopt sustainable agricultural practices such as crop rotation, cover cropping, and integrated pest management can help reduce the need for nitrogenous fertilizers, thereby reducing pollution from fertilizer manufacturing units.

QUE.13). Analyse the steps of sulphuric acid synthesis which contributes towards air pollution, with synthesis with respect to environmental impact. Highlight advantages of the same over conventional process.

Ans: The production of sulphuric acid involves several steps that contribute towards air pollution, including:

1. Combustion of fossil fuels: The production of sulphuric acid requires the combustion of fossil fuels, such as coal or natural gas, which emit greenhouse gases and other air pollutants.
2. Emission of sulphur dioxide: The combustion of sulphur-containing fuels leads to the emission of sulphur dioxide (SO_2), which is a major contributor to acid rain and can cause respiratory problems and other health issues.

3. Nitrogen oxide emissions: The high temperatures involved in sulphuric acid production can also lead to the formation of nitrogen oxides (NO_x), which are another contributor to air pollution and can cause respiratory and other health problems.

Green synthesis of sulphuric acid, using a catalytic process called the H₂O₂-based method, is an alternative method that has several advantages over the conventional process, including:

1. Reduced emissions: The green process does not require the combustion of fossil fuels, resulting in lower greenhouse gas emissions and less air pollution.
2. Lower sulphur dioxide emissions: The green process uses hydrogen peroxide instead of sulphur dioxide to oxidize sulphur, resulting in lower emissions of sulphur dioxide and other pollutants.
3. Lower energy consumption: The green process uses less energy than the conventional process, resulting in lower greenhouse gas emissions and reduced costs.
4. Higher yield: The green process has a higher yield than the conventional process, resulting in less waste and a more efficient use of resources.

QUE.14). Summarize the pollution created by cement manufacturing industries and the measures used to control them.

Ans: Cement manufacturing industries can cause pollution through several processes, including:

1. Emissions of particulate matter and greenhouse gases during the production process, including the mining and transportation of raw materials, the grinding of materials, and the firing of the kiln.
2. Dust emissions during material handling and transportation.
3. Waste generation, including slag, dust, and kiln emissions.

To control the pollution caused by cement manufacturing industries, various measures can be taken, including:

1. Use of alternative fuels and raw materials: The use of alternative fuels, such as biomass, and alternative raw materials, such as fly ash and slag, can reduce greenhouse gas emissions and decrease waste generation.
2. Implementation of pollution control measures: The use of dust collectors, bag filters, and electrostatic precipitators can help control particulate matter emissions.
3. Energy efficiency: Improving energy efficiency through measures such as the use of energy-efficient technologies and waste heat recovery systems can reduce greenhouse gas emissions and lower energy costs.
4. Water conservation: Implementing water conservation measures, such as the use of recycled water and rainwater harvesting, can help reduce water usage and minimize the environmental impact of cement manufacturing.
5. Compliance with regulations: Adherence to regulatory standards, including emissions standards, waste disposal regulations, and environmental permits, can help control pollution from cement manufacturing industries.

QUE.15). Summarize the air pollution caused by Petroleum Industry suitable control methods.

Ans: Petroleum industry is a major contributor to air pollution due to the release of various pollutants, including sulfur dioxide, nitrogen oxides, volatile organic compounds, and particulate matter. To control the air pollution caused by petroleum industry, the following methods can be implemented:

1. Use of clean technologies: The use of cleaner technologies, such as fuel switching, advanced combustion systems, and flue gas treatment, can help reduce emissions of pollutants.

2. **Monitoring and reporting:** Regular monitoring of emissions and reporting of data to regulatory agencies can help identify areas of concern and track progress in reducing emissions.
3. **Maintenance and repair:** Proper maintenance and repair of equipment can help reduce leaks and emissions of pollutants.
4. **Regulation and compliance:** Adherence to regulatory standards, including emissions standards, waste disposal regulations, and environmental permits, can help control pollution from petroleum industry.
5. **Awareness and education:** Raising awareness and educating employees and the public on the importance of reducing emissions and taking steps to control pollution can help foster a culture of environmental responsibility.
6. **Alternative energy sources:** Shifting towards renewable energy sources, such as solar and wind power, can reduce the demand for petroleum and lower emissions of pollutants.

QUE.16). Analyze Geber's process of H_2SO_4 , how it should be control?

Ans: Geber's process of sulfuric acid production is a chemical reaction between sulfur and saltpeter (potassium nitrate) to produce sulfur dioxide, which is then dissolved in water to produce sulfuric acid. While the process is effective for producing sulfuric acid, it can be hazardous to both workers and the environment.

To control the hazards associated with Geber's process, several measures can be taken, including:

1. **Process control:** Monitoring and controlling the reaction conditions, such as temperature, pressure, and reactant ratios, can help prevent unwanted by-products and minimize emissions.
2. **Emissions control:** The use of scrubbers and other emission control equipment can help capture and neutralize any emissions of sulfur dioxide, preventing them from being released into the environment.
3. **Personal protective equipment:** Workers should be provided with personal protective equipment, such as respiratory masks and protective clothing, to minimize their exposure to hazardous chemicals.
4. **Waste management:** Any waste generated during the process should be properly stored, transported, and disposed of in accordance with regulatory requirements.
5. **Training and education:** Workers should be trained on the hazards associated with the process and how to handle and store chemicals safely.

QUE.17). Explain in brief various pollutants released by petroleum industry. Cite an example showcasing the adverse effect of pollution by petroleum industry.

Ans: Petroleum industry is a major source of pollution, releasing a variety of pollutants into the environment. Some of the main pollutants include:

1. **Sulfur dioxide (SO_2):** Released during the combustion of petroleum products, sulfur dioxide can cause respiratory problems and contribute to acid rain.
2. **Nitrogen oxides (NO_x):** Also released during combustion, nitrogen oxides can cause smog, acid rain, and respiratory problems.
3. **Volatile organic compounds (VOCs):** These compounds are released during the production and transportation of petroleum products and can contribute to the formation of smog and ground-level ozone.
4. **Particulate matter (PM):** PM is released during combustion and can cause respiratory problems and cardiovascular disease.

5. Heavy metals: Petroleum products can contain heavy metals such as lead and mercury, which can have toxic effects on human health and the environment.

One example of the adverse effects of pollution by petroleum industry is the Deepwater Horizon oil spill in the Gulf of Mexico in 2010. The oil spill released millions of gallons of crude oil into the ocean, which had devastating effects on marine life and ecosystems. The oil spill also released large amounts of pollutants, including VOCs and particulate matter, into the air, which had negative impacts on the health of workers and nearby communities. The clean-up efforts also generated waste and emissions, further contributing to the pollution. The spill serves as a reminder of the significant environmental and human health risks associated with the petroleum industry and the need to control its pollution.

QUE.18). Cite the preventive measures taken for pollution control by sulphuric acid manufacturing process.

Ans: The manufacturing process of sulfuric acid is a significant source of pollution, particularly due to the emission of sulfur dioxide (SO₂) and nitrogen oxides (NO_x) during the process. To control pollution, various preventive measures can be taken, including:

1. Use of low-emission burners: By using burners that emit lower levels of pollutants, the emissions of SO₂ and NO_x can be reduced.
2. Scrubbing technology: The use of scrubbing technology, such as wet scrubbers or dry scrubbers, can remove pollutants from the exhaust gas before it is released into the atmosphere.
3. Catalysts: Catalysts can be used to promote the conversion of SO₂ to sulfur trioxide (SO₃), which can then be used to produce sulfuric acid. This can reduce the amount of SO₂ that is released into the environment.
4. Recycling: Sulfuric acid can be recycled and reused in the manufacturing process, reducing the need for new production and thus reducing the number of emissions.
5. Process optimization: Optimizing the manufacturing process can reduce the emissions of pollutants by improving efficiency and reducing waste.

These measures can help to control pollution from the sulfuric acid manufacturing process and reduce its environmental impact.

QUE.19). Explain the environmental impact of the following.

i) Ammonia synthesis by Haber's process

ii) Cement industry

iii) Petroleum industry

iv) Fertilizer manufacturing units

v) Sulphuric acid synthesis

Ans: i) Ammonia synthesis by Haber's process: The environmental impact of ammonia synthesis by Haber's process is primarily due to the emission of greenhouse gases such as carbon dioxide and nitrogen oxides during the process. These emissions contribute to climate change and can have adverse effects on air quality. Additionally, the use of fossil fuels as a source of energy for the process contributes to the depletion of non-renewable resources. However, green ammonia synthesis, which uses renewable energy sources, can significantly reduce the environmental impact of the process.

ii) Cement industry: The cement industry is a significant source of air pollution, primarily due to the emission of particulate matter and gases such as carbon dioxide, sulfur dioxide, and nitrogen oxides. The production of cement also requires significant amounts of energy and contributes to the depletion of non-renewable resources. Cement production also has adverse effects on water quality, as it requires large amounts of water for the production process.

iii) Petroleum industry: The petroleum industry is a major source of pollution, both in terms of air and water pollution. The extraction and refining of petroleum release pollutants such as volatile organic compounds, sulfur dioxide, nitrogen oxides, and carbon monoxide, which contribute to air pollution and climate change. Spills and leaks from oil and gas drilling operations can also contaminate water sources and have adverse effects on aquatic ecosystems and human health.

iv) Fertilizer manufacturing units: The manufacturing of nitrogenous fertilizers is a significant source of pollution, primarily due to the emission of nitrogen oxides and ammonia during the production process. These emissions contribute to air pollution and can have adverse effects on human health and the environment. Additionally, the runoff of excess fertilizer into water sources can lead to eutrophication, a process that depletes oxygen in water bodies and harms aquatic life.

v) Sulphuric acid synthesis: The manufacturing of sulfuric acid is a significant source of pollution, primarily due to the emission of sulfur dioxide during the production process. Sulfur dioxide contributes to air pollution and can have adverse effects on human health and the environment. Additionally, the use of non-renewable resources such as fossil fuels in the manufacturing process contributes to climate change and the depletion of non-renewable resources.

Que.20). Explain pollution control in the following

i) Ammonia synthesis by Haber's process

ii) Cement industry

iii) Petroleum industry

iv) Fertilizer manufacturing units

v) Sulphuric acid synthesis

Ans: i) Pollution control in Ammonia synthesis by Haber's process: To control the pollution caused by ammonia synthesis, the following measures can be adopted:

- **Installation of scrubbers:** The gas leaving the synthesis reactor contains unreacted gases like nitrogen, hydrogen, and methane, which are separated from ammonia in the scrubbers. Scrubbers help to remove the unreacted gases, which reduces air pollution.
- **Use of low-NO_x burners:** These burners are used to reduce the production of nitrogen oxides (NO_x) by limiting the amount of oxygen available during combustion.
- **Optimal process design:** Optimal process design and use of modern technologies can help reduce pollution by increasing the efficiency of the process.

ii) Pollution control in Cement Industry: The following measures can be taken to control pollution caused by the cement industry:

- **Use of alternative fuels:** The use of alternative fuels like biomass and waste materials in cement kilns can reduce emissions of greenhouse gases and other pollutants.
- **Use of modern equipment:** Use of modern equipment like baghouse filters, electrostatic precipitators, and scrubbers can help reduce the emissions of particulate matter and other pollutants.
- **Proper waste management:** Proper waste management and disposal practices can help prevent pollution caused by cement industry waste.

iii) Pollution control in Petroleum Industry: The following measures can be taken to control pollution caused by the petroleum industry:

- **Use of advanced refining technologies:** The use of advanced refining technologies like fluid catalytic cracking and hydrotreating can help reduce the emissions of pollutants like sulfur dioxide, nitrogen oxides, and particulate matter.

- Installation of pollution control equipment: Pollution control equipment like flue gas desulfurization systems and catalytic converters can help reduce the emissions of pollutants.
- Proper waste management: Proper management of oil and gas wastes, such as produced water and drilling muds, can help prevent pollution caused by the petroleum industry.

iv) Pollution control in Fertilizer Manufacturing Units: The following measures can be taken to control pollution caused by fertilizer manufacturing units:

- Use of cleaner production technologies: The use of cleaner production technologies like low-NOx burners and scrubbers can help reduce emissions of pollutants.
- Proper management of waste materials: Proper management of waste materials like spent catalysts and sludge can help prevent pollution caused by fertilizer manufacturing.
- Use of alternative energy sources: Use of alternative energy sources like solar and wind energy can help reduce greenhouse gas emissions.

v) Pollution control in Sulphuric Acid Synthesis: The following measures can be taken to control pollution caused by sulphuric acid synthesis:

- Use of low-emission technologies: The use of low-emission technologies like fluidized bed combustion and electrostatic precipitators can help reduce emissions of pollutants like sulfur dioxide and particulate matter.
- Use of efficient sulfur recovery technologies: Efficient sulfur recovery technologies like Claus process can help prevent the emission of sulfur dioxide into the atmosphere.
- Proper management of waste materials: Proper management of waste materials like spent catalysts and slag can help prevent pollution caused by sulphuric acid synthesis.

QUE.21). Define Industrial pollution. How fossil fuel contributes towards industrial pollution? (3)

Ans: Industrial pollution refers to the release of harmful substances and pollutants into the environment as a result of industrial activities. It is a major concern for environmental and public health. The sources of industrial pollution include factories, power plants, oil refineries, chemical plants, and other industrial facilities.

Fossil fuels, such as coal, oil, and natural gas, are used extensively in the industrial sector for energy and production purposes. The burning of fossil fuels releases a variety of pollutants, including carbon dioxide, sulfur dioxide, nitrogen oxides, and particulate matter, into the air. These pollutants contribute significantly to industrial pollution, which can lead to a range of environmental and health problems such as acid rain, respiratory illnesses, and global warming.

In addition to air pollution, fossil fuel usage in industrial processes also contributes to water pollution and soil contamination through the release of hazardous chemicals and waste materials. Therefore, reducing the reliance on fossil fuels and implementing cleaner technologies is crucial for mitigating the impact of industrial pollution on the environment and human health.

QUE.22). What are the major factors responsible for industrial waste production? Distinguish Process waste and Chemical waste.

Ans: Industrial waste production is influenced by several factors, including:

1. Type of industry: Different industries produce different types of waste, depending on the nature of the manufacturing process and the raw materials used.
2. Production volume: The amount of waste generated by an industry is directly proportional to the production volume.

3. Technological advancements: Modern industrial processes and technologies have reduced waste production and improved waste treatment and disposal methods.
4. Regulatory requirements: Governments have implemented regulations and guidelines to control and manage industrial waste production, treatment, and disposal.

Industrial waste can be broadly classified into two types: Process waste and Chemical waste.

Process waste is generated during the manufacturing process and includes materials such as scrap metal, sawdust, and wastewater from washing and cooling operations.

Chemical waste, on the other hand, refers to hazardous materials generated by industrial processes, such as solvents, acids, and heavy metals. These substances are harmful to the environment and pose a significant risk to human health.

To manage and dispose of industrial waste effectively, it is crucial to identify and segregate process waste from chemical waste. Process waste can often be recycled or reused, reducing the amount of waste sent for disposal. Chemical waste, on the other hand, requires specialized treatment and disposal methods to prevent contamination of the environment and harm to human health.

QUE.23). What is the role of N₂ in Plant growth? What are the Natural sources for plants to obtain N₂?

Ans: Nitrogen is an essential element for plant growth and is a vital component of many biological molecules, such as amino acids, nucleic acids, and chlorophyll. Nitrogen is found in many forms in the environment, but plants can only use it in the form of ammonium (NH₄⁺) or nitrate (NO₃⁻).

In its atmospheric form, nitrogen gas (N₂) is relatively inert and cannot be utilized directly by plants. However, certain microorganisms, such as nitrogen-fixing bacteria and cyanobacteria, can convert atmospheric nitrogen gas into ammonium or other forms that plants can use. This process is called nitrogen fixation.

Some plants have a symbiotic relationship with nitrogen-fixing bacteria, which live in nodules on the plant's roots. The bacteria provide the plant with usable nitrogen, and in return, the plant provides the bacteria with nutrients and a place to live.

Other sources of nitrogen for plants include organic matter, such as decomposing plant material and animal waste, and nitrogen-based fertilizers.

QUE.24). State the impact of Nitrogenous fertilizers on environment. Discuss the possible solution also.

Ans: The use of nitrogenous fertilizers can have significant impacts on the environment. Here are some of the main impacts:

1. Water Pollution: Nitrogenous fertilizers can leach into groundwater and surface water, leading to high levels of nitrates in drinking water. This can cause a number of health problems, especially for infants and pregnant women.
2. Soil Degradation: Overuse of nitrogenous fertilizers can degrade the soil quality by reducing soil organic matter, altering soil pH, and reducing microbial activity.
3. Air Pollution: The use of nitrogenous fertilizers can contribute to air pollution through the release of ammonia, nitrous oxide, and other greenhouse gases.
4. Climate Change: Nitrous oxide is a potent greenhouse gas, and the use of nitrogenous fertilizers is a major contributor to its release into the atmosphere.

To mitigate the negative impacts of nitrogenous fertilizers on the environment, several solutions can be adopted:

1. Precision farming techniques can be used to apply fertilizers in a more targeted and efficient manner, reducing the amount of fertilizer required.
2. Use of organic fertilizers and manure can help to reduce the use of nitrogenous fertilizers, while also improving soil quality and reducing greenhouse gas emissions.
3. Crop rotation and intercropping can help to reduce the need for nitrogenous fertilizers, as certain crops can fix nitrogen from the air and make it available to other crops.
4. Government regulations and incentives can encourage farmers to adopt sustainable practices, such as reducing fertilizer use and adopting conservation tillage techniques.

QUE.25). What are Nitrogenous fertilizers? In what way they increase the fertility of soil? (3)

Ans: Nitrogenous fertilizers are a type of fertilizer that contains nitrogen as the main nutrient. These fertilizers are commonly used in agriculture to increase the nitrogen content in the soil, which can improve plant growth and crop yield.

When nitrogenous fertilizers are applied to the soil, they release nitrogen into the soil in the form of ammonium, nitrate, or urea. Plants can then absorb this nitrogen through their roots and use it to make important molecules such as amino acids, nucleic acids, and chlorophyll.

Nitrogen is a critical nutrient for plant growth, and a lack of nitrogen can limit plant growth and reduce crop yield. Nitrogenous fertilizers help to increase the nitrogen content in the soil, which can improve plant growth and increase crop yield.

However, excessive use of nitrogenous fertilizers can have negative environmental impacts, such as contaminating groundwater and contributing to air and water pollution. It is important to use nitrogenous fertilizers in a responsible and sustainable manner, taking into account factors such as soil conditions, crop needs, and environmental impact.

QUE.26). State the pollution caused by irrational use of nitrogenous fertilizers in air, water and soil.

Ans: The irrational use of nitrogenous fertilizers can cause various types of pollution in air, water, and soil. Some of the major pollutants include:

1. Nitrogen Oxides (NO_x): The excessive use of nitrogenous fertilizers leads to the emission of nitrogen oxides, which can cause smog, acid rain, and respiratory problems.
2. Ammonia (NH₃): Ammonia is released into the air as a by-product of fertilization and animal waste. It can cause respiratory problems, eye irritation, and even death in high concentrations.
3. Nitrate (NO₃): Nitrate is a common pollutant in groundwater and surface water. It can cause oxygen depletion in aquatic ecosystems, leading to the death of fish and other aquatic organisms.
4. Eutrophication: Nitrogenous fertilizers can lead to eutrophication, which is the excessive growth of algae and other aquatic plants. This can lead to oxygen depletion in water bodies, leading to the death of fish and other aquatic organisms.
5. Soil Acidification: The excessive use of nitrogenous fertilizers can lead to soil acidification, which can reduce soil fertility and decrease crop yields.

To control these pollutants, proper management of nitrogenous fertilizers is necessary. This includes using fertilizers at the recommended rates, optimizing the timing and method of application, and implementing conservation practices such as crop rotation and cover cropping. Additionally, the use of alternative, organic fertilizers can also help reduce pollution caused by nitrogenous fertilizers.