5.4 CARBON SEQUESTRATION

Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide. It is one method of removing carbon dioxide from the atmosphere and held in solid or liquid form.

Carbon capture and sequestration is the process of capturing waste carbon dioxide (CO_2) from large point sources, such as fossil fuel power plants, transporting it to a storage site, and depositing it where it will not enter the atmosphere, normally an underground geological formation.

Carbon dioxide is naturally captured from the atmosphere through biological, chemical, and physical processes. These changes can be accelerated through changes in land use and agricultural practices, such as converting crop and livestock grazing land into land for non-crop fast-growing plants. Artificial processes have been devised to produce similar effects, including large-scale, artificial capture and sequestration of industrially produced carbon dioxide using subsurface saline aquifers, reservoirs, ocean water, ageing oil fields, or other carbon sinks, bio-energy direct air capture when combined with storage.

TYPES OF CARBON SEQUESTRATION

There are three types of Carbon Sequestration biological, geological, and technological Carbon Sequestration or storing.

BIOLOGICAL CARBON SEQUESTRATION -

More than half of the carbon emissions are stored in soil and oceans. By taking advantage of this, it is possible to store carbon naturally for a very long time, thousands of years in some cases.

Plants and trees store carbon in the soil as organic compounds, and they are called Soil Organic compounds (SOC). However, aggressive agricultural practices can quickly deplete these carbon deposits.

GEOLOGICAL CARBON SEQUESTRATION -

Just like biological Carbon Sequestration, geological Carbon Sequestration is a natural process where rocks can store carbon. Carbon emissions from large manufacturing units are captured and injected into rocks. This process is called Carbon Sequestration.A

thorough site selection is done to identify ideal geological formations for carbon storage. Access to the site, geological features, and capacity to hold carbon are some criteria for selecting the right site. The most expensive part of geological Carbon Sequestration is extracting carbon dioxide gas from the pollutant.

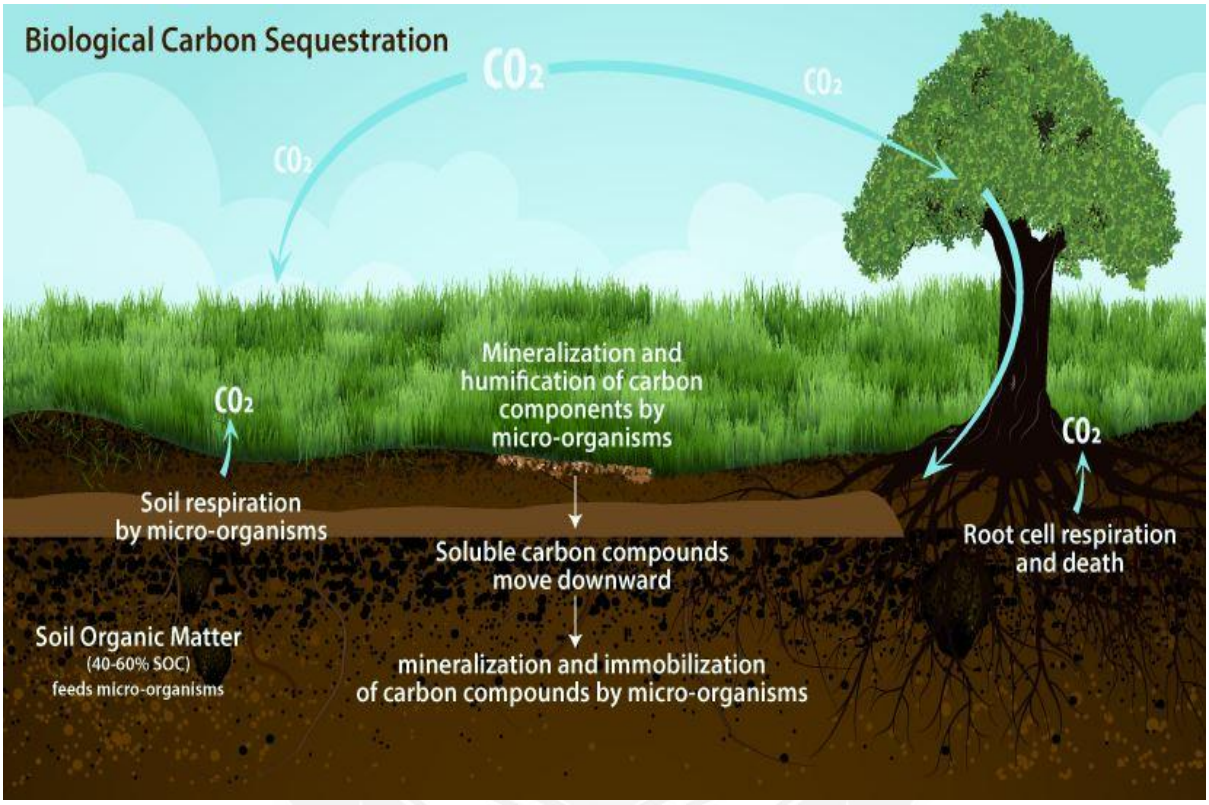

FIG.5.4.1BIOLOGICAL CARBON SEQUESTRATION

Carbon sequestration is the process of capturing carbon dioxide (CO2) from the atmosphere or from industrial sources and storing it in long-term reservoirs, such as forests, oceans, geological formations, or engineered systems, to mitigate climate change. There are several methods of carbon sequestration:

1. **Terrestrial Sequestration**:

    - **Afforestation and Reforestation**: Planting trees or restoring forests to absorb CO2 from the atmosphere through photosynthesis and store it in biomass and soils.

    - **Soil Carbon Sequestration**: Practices such as conservation tillage, cover cropping, and improved land management techniques can enhance the storage of carbon in soils.

2. **Ocean Sequestration**:

    - **Ocean Fertilization**: Adding nutrients to surface waters to stimulate phytoplankton growth, which absorbs CO2 during photosynthesis. However, the effectiveness and potential environmental impacts of this method are still under research and debate.

    - **Enhanced Oceanic Weathering**: Accelerating the natural process of weathering of silicate rocks in coastal areas to increase the uptake of CO2 by the ocean.

3. **Geological Sequestration**:

    - **Carbon Capture and Storage (CCS)**: Capturing CO2 emissions from industrial sources, such as power plants or cement factories, and injecting it into deep geological formations, such as depleted oil and gas reservoirs, saline aquifers, or deep coal seams, where it can be stored permanently.

4. **Direct Air Capture (DAC)**:

    - **Mechanical Systems**: Using chemical sorbents or solvents to capture CO2 directly from the atmosphere, followed by compression and storage.

    - **Biological Systems**: Utilizing engineered or natural biological processes, such as photosynthesis in algae or other plants, to capture and convert CO2 into biomass or other products.

Carbon sequestration can help mitigate climate change by removing CO2 from the atmosphere, thereby reducing greenhouse gas concentrations and slowing global warming. However, it is not a standalone solution and should be implemented alongside efforts to reduce emissions and transition to renewable energy sources.

While carbon sequestration technologies hold promise, there are also challenges and considerations, including cost-effectiveness, scalability, permanence of storage, environmental impacts, and social acceptability. Continued research, development, and deployment of carbon sequestration methods are necessary to enhance their effectiveness and contribute to climate change mitigation efforts.

Advantages

Planting trees and managing their development is a proven way to reduce the number of harmful particulates in the air. Carbon sequestered is carbon not emitted into the atmosphere. Less carbon in the atmosphere will reduce the greenhouse gas effect and lessen the impacts of climate change.

Disadvantages

- Carbon dioxide may be stored deep underground. At depth, hydrostatic pressure acts to keep it in a liquid state. Reservoir design faults, rock fissures, and tectonic processes may act to release the gas stored into the ocean or atmosphere.
- The use of the technology would add 1–5 cents of cost per kilowatt-hour, according to an estimate made by the panels about climate change. The financial costs of modern coal technology would nearly double if the use of CCS technology were to be required by regulation. The cost of CCS technology differs from the different types of capture technologies being used and with the different sites that it is implemented in, but the costs tend to increase with CCS capture implementation. One study conducted predicted that with new technologies these costs could be lowered but would remain slightly higher than prices without CCS technologies.

Carbon sequestration, the long-term storage of carbon in plants, soils, geologic formations, and the ocean. Carbon sequestration occurs both naturally and as a result of anthropogenic activities and typically refers to the storage of carbon that has the immediate potential to become carbon dioxide gas. In response to growing concerns about climate change resulting from increased carbon dioxide concentrations in the atmosphere, considerable interest has been drawn to the possibility of increasing the rate of carbon sequestration through changes in land use and forestry and also through geoengineering techniques such as carbon capture and storage. Carbon sequestration and climate change mitigation

The Kyoto Protocol under the United Nations Framework Convention on Climate Change allows countries to receive credits for their carbon-sequestration activities in the area of land use, land-use change, and forestry as part of their obligations under the protocol. Such activities could include afforestation (conversion of nonforested land to forest), reforestation (conversion of previously forested land to forest), improved forestry or

agricultural practices, and revegetation. According to the Intergovernmental Panel on Climate Change (IPCC), improved agricultural practices and forest-related mitigation activities can make a significant contribution to the removal of carbon dioxide from the atmosphere at relatively low cost. These activities could include improved crop and grazing land management—for instance, more efficient fertilizer use to prevent the leaching of unused nitrates, tillage practices that minimize soil erosion, the restoration of organic soils, and the restoration of degraded lands. In addition, the preservation of existing forests, especially the rainforests of the Amazon and elsewhere, is important for the continued sequestration of carbon in those key terrestrial sinks.

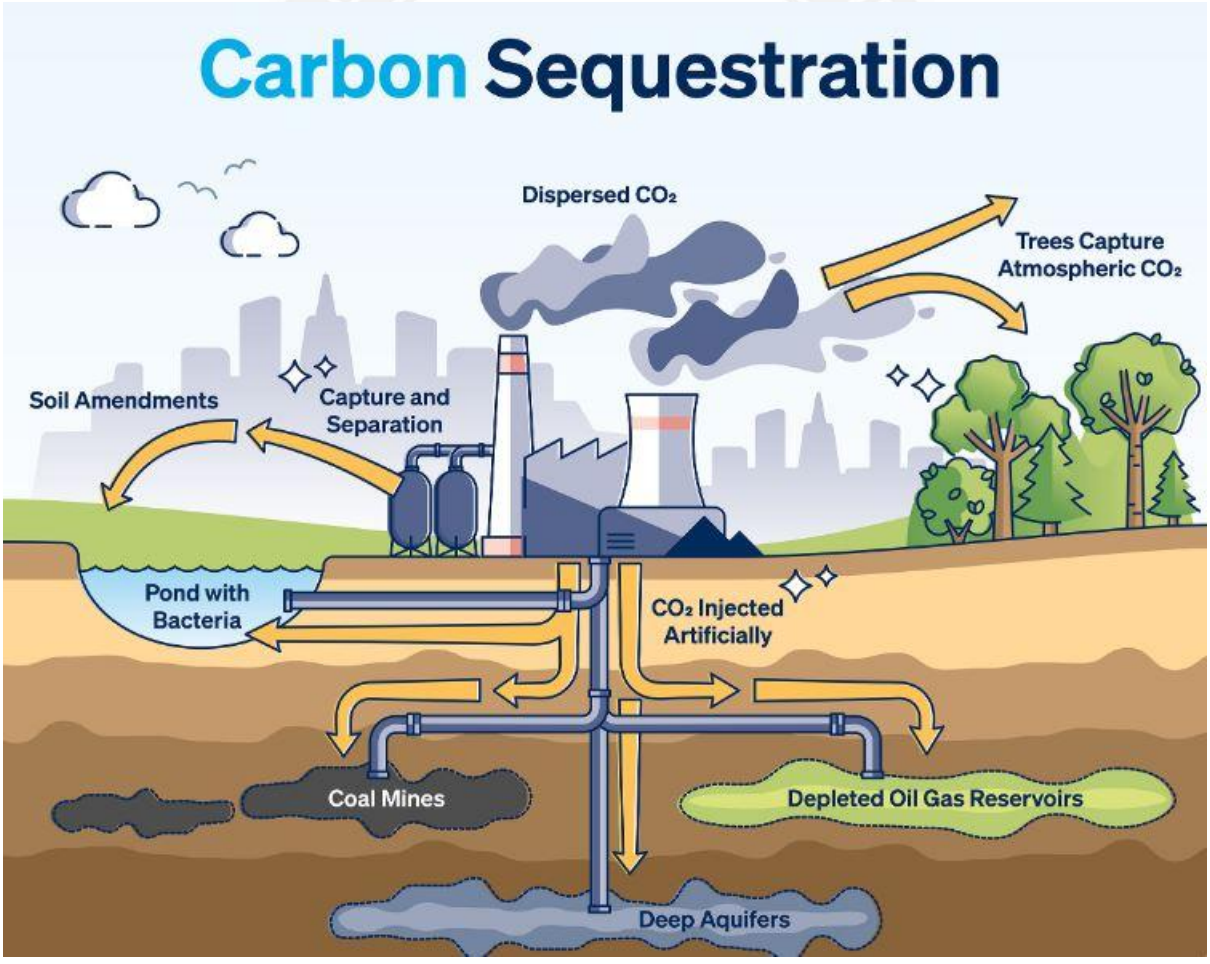

FIG.5.4.2 CARBON SEQUESTRATION