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Unlocking the Potential of Carbon Sequestration: A Pathway to Climate Change Mitigation

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SUMMARY

Greenhouse effect is the major contributor to the rising global average temperature. The main cause of increasing global warming is the reliance on fossil fuels for primary energy supply. In India, coal currently contributes around 60% to electricity generation. Coal continue to be a major contributor of power generation in India for the upcoming few decades because the coal is the one of the major source, made of 90% of carbon. Emission of carbon in the form of carbon dioxide increased during the process of producing electricity where in the coal gets decomposed into carbon dioxide. Carbon sequestration is the method of abstracting the generated carbon dioxide and safely storing it. This method is used to maintain the optimum level of carbon dioxide in the environment.

INTRODUCTION

Carbon sequestration is defined as the **C**arbon dioxide is captured and stored in natural and manmade products and process is known as carbon sequestration. This assumes importance in the context of extreme climate change and global warming.

There are 2 steps involved in carbon sequestration.

1. Capturing of carbon dioxide
2. Storing of carbon dioxide

Capture processes

The capture step involves, removal, purification and compression of CO2 separated from the flue gas (flue gas is the gas emitted from the combustion of fuel and plant resources). CO2 is separated from the effluent or the source of emission, it is captured by using vacuum pump and it is compressed to a liquid state. This results in higher concentrations of CO2 (>99%) Capture is necessary to transport and store the CO2 economically, comprising of following steps.

1. Post combustion capture
2. Oxy –combustion capture
3. Pre –combustion capture

Post combustion capture

Post-combustion capture is a form of flue-gas clean-up and this process is done at the back end of the industries. The emitted gases and the exhaust gases, a mixture of CO2, nitrogen and some oxygenated compounds (SO2, NO2 and O2) are first treated to remove particulate matter and the oxides of nitrogen and sulphur, in this process alkaline chemical like mono ethanolamine is used, which absorbs the carbon dioxide. This process is executedat the back end of power plant.

Oxy-combustion

Since the nitrogen is found in large amount with carbon dioxide,it is essential to separate the nitrogen-carbon dioxide. After nitrogen elimination, the oxygen is pumped into the plants, which forms carbon dioxide water mixture. Water can easily be removed and carbon dioxide is captured. The primary separation process here is of oxygen from nitrogen. This is done in a standard air separation unit (ASU), but it has a large load of about 15 per cent of a power plant's electric output. Once water is separated, the flue gas is 90 per cent CO2.

Pre-combustion

This process is primarily used in the plant like integrated coal gasification combined cycle. Conventional coal-fired thermal power stations burn coal and use the heat to produce steam. The steam powers the steam turbines, which then generate electricity. In this process, the carbon dioxide released during the

combustion of coal ,that gas is made to react with hydrogen and water to produces synthetic gas, through this the carbon dioxide is captured.

Storing the carbon dioxide

1. Terrestrial carbon sequestration
2. Geologic carbon sequestration
3. Ocean carbon sequestration

Terrestrial carbon sequestration

It is the process through which carbon dioxide from atmosphere is absorbed by tree and plants through photosynthesis and stored as carbon in soil and biomass such as trunks, branches. Once the plant dies, or as limbs, leaves, seeds, or blossoms drop from the plant, the plant material decomposes and the carbon is released. Trees are valuable as greater amounts of carbon are tied up for longer time periods.

Geologic carbon sequestration

Carbon dioxide can be stored, including oil reservoirs, gas reservoirs, mineable coal seams, saline formation and shale formation with high organic content. Fluid is injected deep into these geological storage sites by pumping the fluid into a well. The storage well is perforated to allow the CO2 to enter the formation. The perforation is usually of 10–100 m thickness, depending on the permeability and thickness of the formation. The pressure caused by the injection drives the CO2 to displace the fluid already present in the formations. The rate of injection, permeability, thickness and the permeability of the formation ultimately determine the amount of pressure of the injection, where CO2 is trapped in the seal or it gets absorbed on the coal micro pores or gets converted to minerals.

Ocean carbon sequestration

Oceans absorbs, release and store large amounts of carbon dioxide from the atmosphere this can be done in two ways enhancing productivity of ocean biological systems.

- Iron fertilization is a technique in which waste iron scraps and other form of iron is dumped into the ocean, when the iron starts to decompose, the marine system is now enriched with ferrous ions, which stimulates the faster growth of the phytoplankton. The dumping of iron stimulates phytoplankton production which leads to enhanced photosynthesis from these microorganisms, helping in carbon dioxide absorption
- Injecting carbon dioxide into the deep ocean.

Other methods

Natural carbon sequestration

It is the process by which nature balance the carbon dioxide in atmosphere, nature provides the trees, plants for photosynthesis and ocean, earth and the animals themselves as the carbon sinks or sponges. The entire living organism is carbon based and when they die the carbon again goes to the ground through the process of decomposition, but this situation create very little impact. The biological carbon sequestration happens when carbon is stored in the natural environment. This includes what are known as 'carbon sinks', such as forests, grasslands, soil, oceans and other bodies of water. This is also known as an 'indirect' or passive form of sequestration.

Artificial carbon sequestration

Artificial carbon sequestration refers the capturing of carbon emission at the point of production (e.g. factory chimneys) and then it is buried, for example if a factory is situated near a lake, the emitted carbon dioxide is captured and stored by injecting the gas form into liquid form under the bottom of the lake. This refers the carbon capture at the place of the production itself and buried or otherwise the carbon is injected deep into the ocean, deep down into the bottom. Over the period of time they dissolved into the water column. This man-made method of capturing emitted carbon can be classified as geological injection or ocean injection,

Advantages of carbon sequestration

- This absorption of extra carbon dioxide helps in the balancing of carbon dioxide in the atmosphere prevents the drastic changes in climate change.
- This trapping of excess of carbon dioxide decreases the risks of global warming

- Reduction in acidification of ocean
- Due to storage of carbon source in the deep areas this replenishes the fossil resource

Disadvantages of carbon sequencing

- The methods like injection of carbon dioxide can sometime results in leaks due to structural flaws in the geological formation.
- If the ocean injection method is used frequently, this leads to acidic condition of ocean
- Technologically difficult, expensive and time consuming too.

CONCLUSION

These methods are efficient but the expensive too, the emission of carbon dioxide is mainly due anthropogenic activities and various technologies have been devised to increase ocean CO2 storage. The CO2 can be transported via ship and can be injected directly in the ocean. CO2 loaded on ships could either be dispersed from a pipe or transported to fixed platforms feeding a CO2 to a lake on the sea floor. Such CO2 lakes must be deeper than 3 km where CO2 is denser than sea water. The best and simplest way is plantation of trees and plants and we should also use the policy of reuse, reduce and recycle because the change starts when we start to change.

REFERENCES

Kartika Srivastava, Carbon Capture and Sequestration: An Overview, International Journal for Research in Applied Science & Engineering Technology, Volume 9 Issue XII, 2021

Keith, D. W. (2009). "Why capture CO2 from the atmosphere?" Science, 325(5948), 1654-1655.

Rattan Lal Philos Trans R Soc Lond B Biol Sci. 2008 Feb 27; 363(1492): 815–830.Published online 2007 Aug 30. Doi: 10.1098/rstb.2007.2185