

# Carbon Sequestration using Multiphase Pump

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**Abstract:** Carbon dioxide is a harmful gas and is leading us to a globally warmer environment. This deciphered the concept of capturing carbon dioxide from air and storing it in places which would not be vulnerable and out of reach from reentering the atmosphere. Carbon sequestration is a highly challenging technology and is therefore quite limited in its application till date. Though there are several practical applications that have been structured out and is very well used. Coming across from capturing and then storing, the process involves a huge implementation of technology. Storing the captured carbon dioxide into exhausted oil and gas beds under sea is supposedly the best option till date. Transferring down the carbon dioxide is usually mapped by using booster pumps. As an alternative multiphase pumps can also be utilized owing to its versatile features.

**Keywords:** Carbon Sequestration, Carbon Capture, Multi-phase Pumping, Geological Sequestration, Carbon Emission, Global Warming.

## 1. Introduction:

Carbon negative is a phrase that is used to describe any activity that involves in mitigating carbon dioxide from the atmosphere. Carbon footprint can never be reduced zero or negative. Technically it is utmost challenging and would require extensive research to finally establish a system. In India unfortunately carbon capture and sequestration has not marched out of the laboratory scale yet, since the major hindrances being economic policies and unavailability of geological sequestration sites. Out of the existing beds, in states of India like Assam, where oil reserves are competitive, flushing captured carbon dioxide may lead to geological degradation owing to its geographical features.

Talking about the global carbon emissions from fossil fuel combustion and from industrial processes, there has always been an upscale trajectory. The top 3 emitting regions in 2013, together accounting for more than half (55%) of global carbon dioxide emission are China (10.3 billion tons CO<sub>2</sub> or 29%), the United States (5.3 billion tons CO<sub>2</sub> or 15%) and the European Union (EU28) (3.7 billion tons CO<sub>2</sub> or 11%).

**CO<sub>2</sub> emissions from fossil-fuel use and cement production in the top 5 emitting countries and the EU**

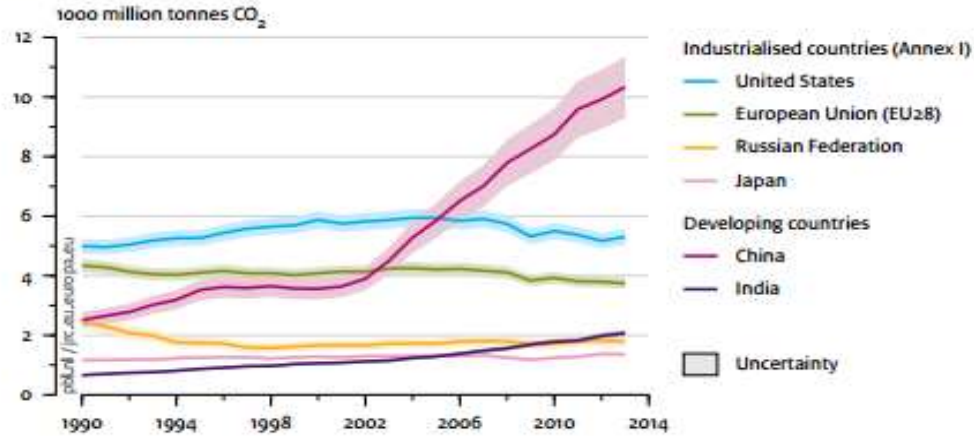


Fig: 1

**2. Country wise emission data:**

| COUNTRY   | 2010-14, CO2 Emissions MT/Capita |
|-----------|----------------------------------|
| UAE       | 19.9                             |
| USA       | 17.6                             |
| AUSTRALIA | 16.9                             |
| UK        | 7.9                              |
| CHINA     | 6.2                              |
| FRANCE    | 5.6                              |
| INDIA     | 1.7                              |

Table: 1

Carbon dioxide emission is accelerating at an enormous rate and to combat this there are various mitigation and adaptation initiatives that are being taken in every country.

Every year countries submit their INDC reports wherein they specify their commitments towards climate change initiatives, this year already 14 countries have committed to their INDC commitments.

### 3. The Overall Process:

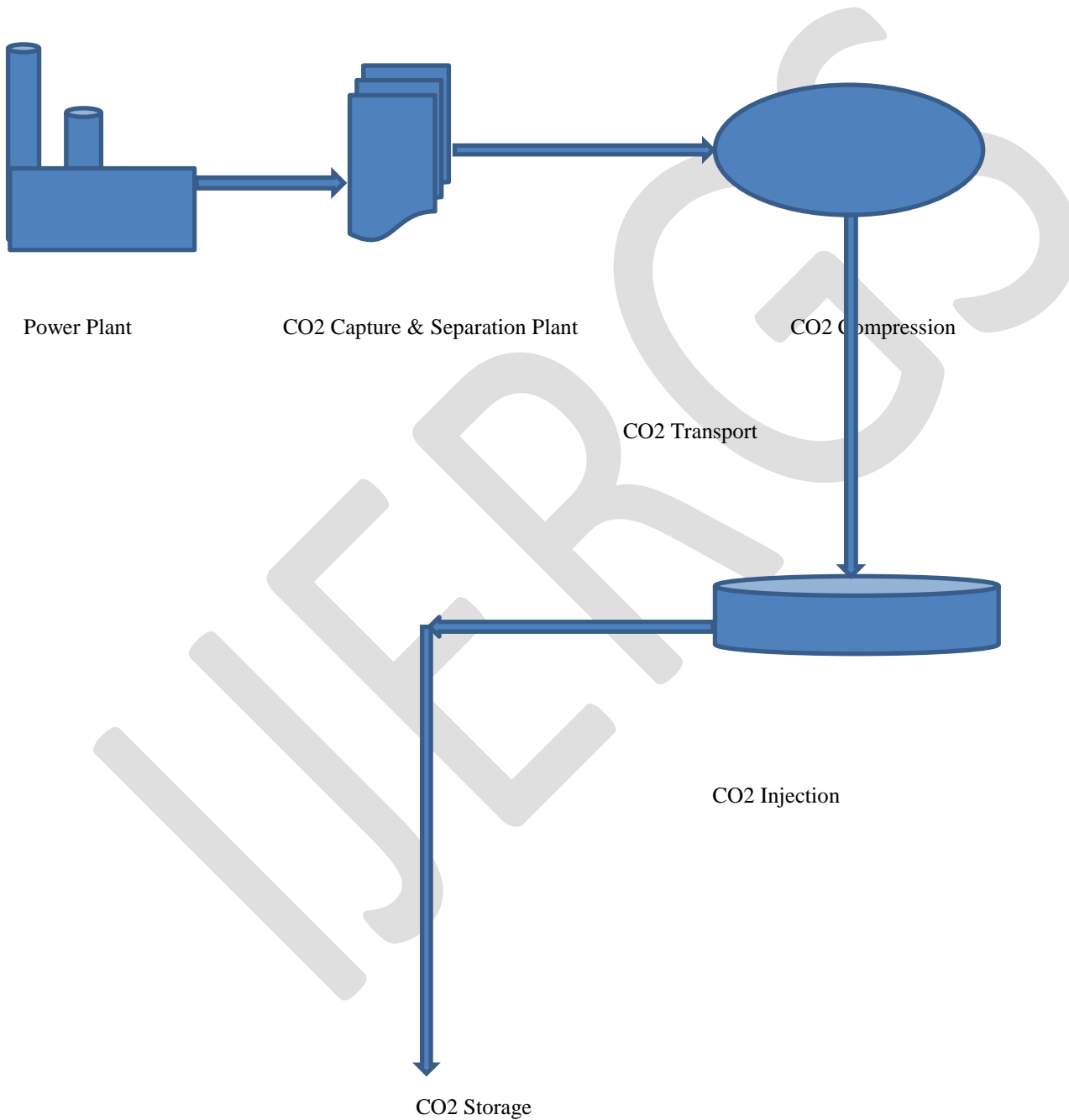


Figure: 2

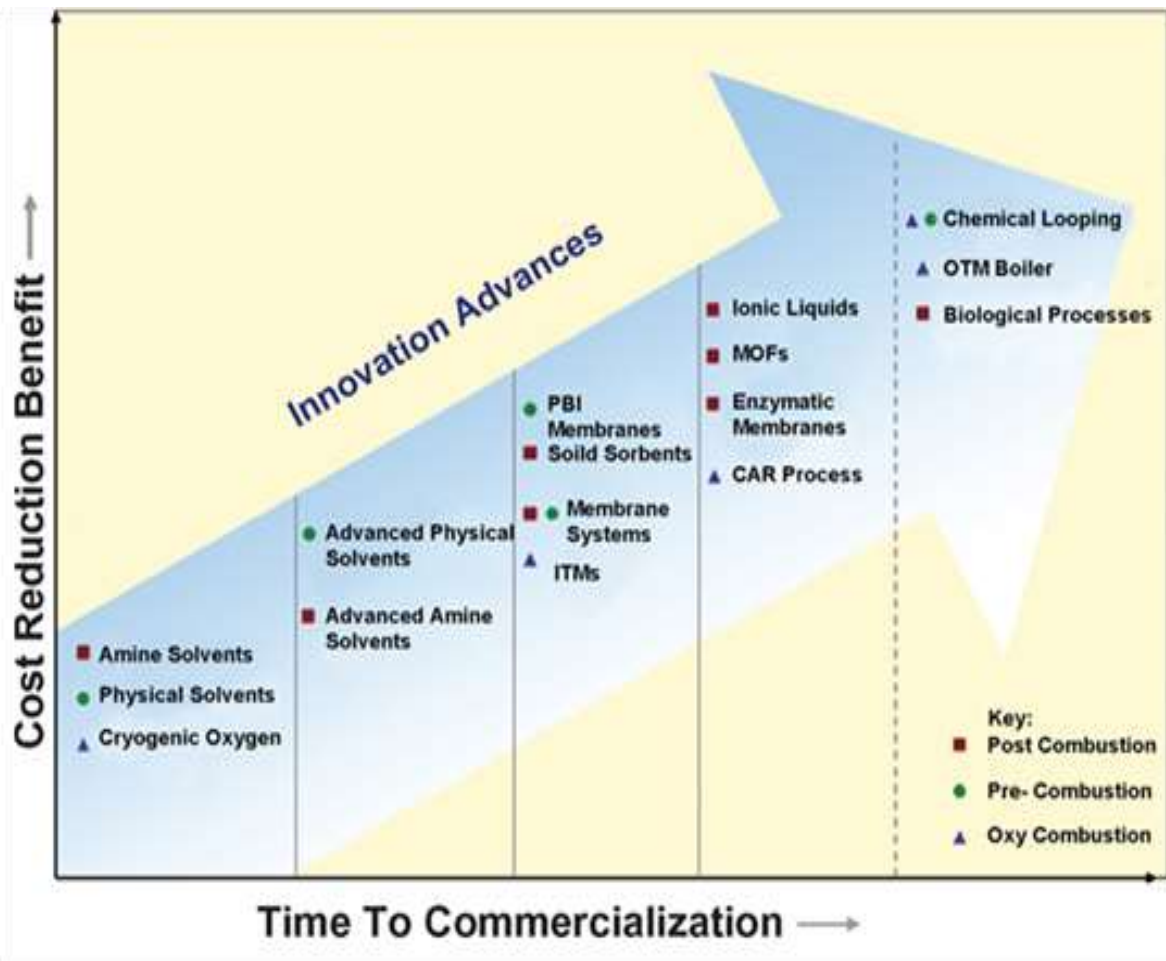


Figure: 3

#### 4. Current Status Worldwide:

With the advent of carbon sequestration technology implementation widely in countries like US, Canada, United Kingdom, a large number of CCS projects are identified studying their feasibility. Few of the potential areas are Japan, China, and Australia.

Globally, there are 13 large-scale Carbon Capture and Sequestration projects in operation, with a further nine under construction. The total CO<sub>2</sub> capture capacity of these 22 projects is around 40 million tons annually provision of 56 projects are identified.



Figure: 4

#### 5. Challenges in the existing Booster Pumps for sequestration:

A booster pump is a machine that increase the pressure of a fluid, generally a liquid. It is very similar to a gas compressor, but generally a simpler mechanism which often has only a single stage of compression, which is used to increase pressure of an already pressurized gas. Multi stage boosters are also operational. Boosters may be used for increasing gas pressure, transferring high pressure gas, charging gas cylinders and scavenging

Booster pumps are equipped with limited production and flow ability. There are chances of aberrant flow into wells. Naturally booster pumps present onshore and topside are designed to work in a limited working region with specific differential pressure and flow rate. It is only possible to maintain it once in 2 or 3 years. Auxiliary equipment's like separators, compressor, flow lines maintaining is difficult and requires the process to go under stagnancy, one of the biggest limitations being its inability to handle both liquid and gas.

Hence the above cited limitations increases not only the technical complexity but also digs deep into the economic aspects of carrying out the operation as a whole.

### 6. Prescribed Alternative:

As a suggestive measure, an alternative can be the Implementation of twin screw multiphase pump.

Twin screw multiphase pump is a positive displacement pump. Positive-displacement pumps operate by forcing a fixed volume of fluid from the inlet pressure section of the pump into the discharge zone of the pump. These pumps generally tend to be larger than equal-capacity dynamic pumps. They provide a fixed displacement per revolution and, within mechanical limitations, infinite pressure to move fluids. Twin screw multiphase pump has the possibility to vary the pump speed between approximately 30 and 130 percent of the design speed

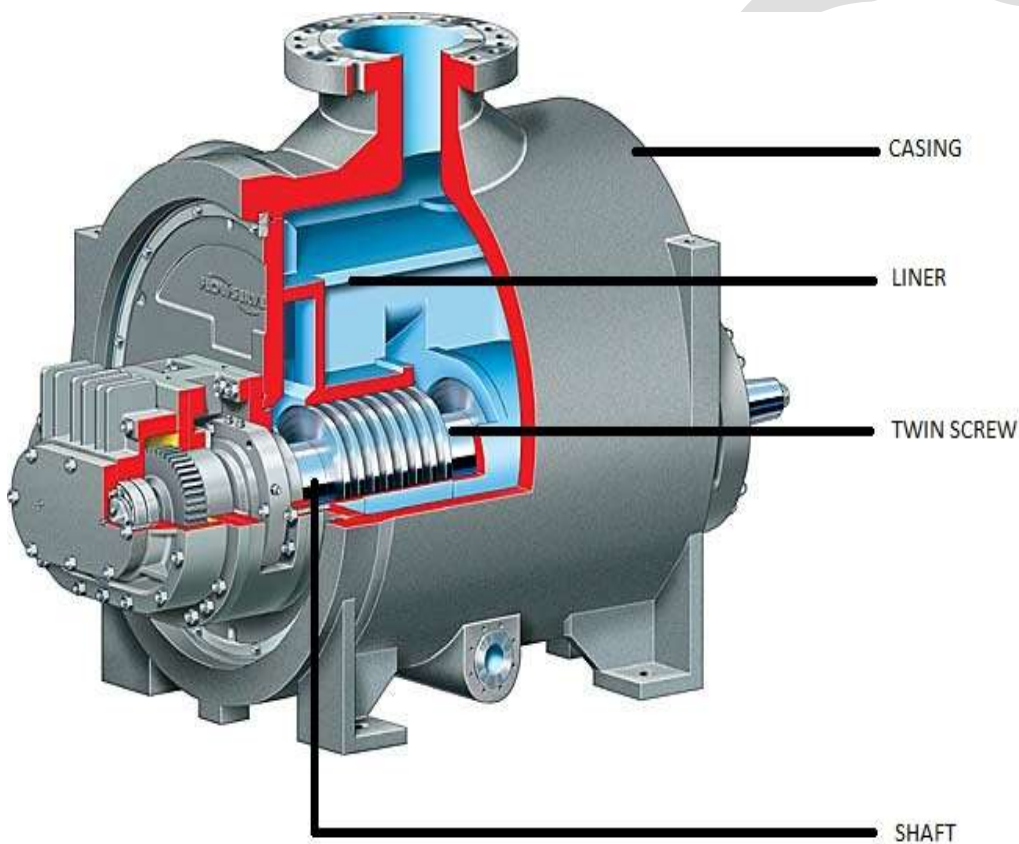


Figure: 5

**7. Operating Parameters:**

- Flows up to 2258 m<sup>3</sup>/h
- Pressure up to 1100 bar ; custom designs for higher pressures
- Temperatures to 450°C (842°F)
- Viscosities to 8000 Centipoise
- Gas volume fractions from 0% to 100%

**8. Features:**

- They can handle considerably high flow rates and pressures at a high gas volume fraction
- The selection of the wetted construction materials must follow the current NACE requirements, which it does.
- They can be found on well head platforms offshore, on onshore field far away from the production facilities or subsea.

**9. Comparative Analysis:**

| <b>TWIN SCREW MULTIPHASE PUMP</b>                               | <b>BOOSTER PUMP</b>   |
|---|---|
| Capacity : Flow rate ranging from 2000-2500 m <sup>3</sup> / hr | Capacity : Flow rate ranging from 300-1800m <sup>3</sup> / hr |
| Temperature : Hadalpelagic region is ranged -20 to 450 degree   | Temperature : Hadalpelagic region is ranged -15 to 370 degree |
| Pressure : Up to 1100bar  | Pressure : Up to 750 bar                                      |
| Energy consumed : 44%   | Energy consumed : 37%   |
| Lesser Environmental Impact : Around 11%                        | Comparatively Higher Environmental Impact : 18%               |

**Table: 2**

**Advantages of Twin Screw Multiphase pumping over Booster pump in sequestration process:**

- ▶ Accelerates and increases the flow ability
- ▶ Stabilizes flow in wells that cannot naturally produce to remote facilities
- ▶ Extends subsea tieback distance
- ▶ Reduces well intervention cost
- ▶ Reduces subsea development cost
- ▶ Operates in an environment friendly way

- ▶ Permits flow in a harsh environment
- ▶ Eliminates offshore flaring and saves the relevant costs
- ▶ Reduces backpressure at wellhead

#### 10. Conclusion:

It is extremely crucial to mitigate carbon emissions and hence technologies like carbon capture should be highly encouraged. Usage of Multiphase pumps in sequestration operations has the ability to show greater flexibility than existing booster pumps if incorporated. Climate change and environmental change are crying havoc owing to capricious changes in biosphere, hence needs stern measures of control.

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