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Space Laboratory Alterations: Techniques in Detrital CO_2 Emission Mitigation

Mubarak N[1], Kankara, I. A[2*]

[1] *Dept. of Civil Engineering and Geochemistry, Newcastle University, UK*
[2] *Department of Geology, Federal University Dutsin-Ma, Nigeria*

***Corresponding Author:** Kankara, I. A, Department of Geology, Federal University Dutsin-Ma, Nigeria, Email: alertmnassk@hotmail.com*

ABSTRACT

Space Laboratory is the sum total of all ecosystems and the many external influences that affect them, including the Co_2 sink and capture that facilitated climate change and or Greenhouse effect. This present paper discusses the magnitude of these effects and further suggested the need for technique(s) to address the global potential emission of CO_2. The methodology adopted for the study was mainly primary data which dwelled on the laboratory techniques on the recent scientific advancements in CO_2 mitigation technique which also focuses significantly on Carbon capture and storage (CCS), which is potential to stabilize the CO_2 concentration in the ambient air within (10-20 years) This however saw many factors of Carbon IV oxide sequestering methods, but further discusses some of the hindrances towards the geological Carbon IV oxide capturing storages. The results showed that the Geological Carbon Capture Storage (CCS) adopted in the research is the best method since over 80% of Carbon IV oxide emission was mitigated. It was recommended that both International donor Agencies and nations should partake in curtailing the emission.

Keywords: *Geological Carbon Capture Storage (GCCS), Emission, Mitigation Techniques, Hindrances.*

INTRODUCTION

The CO_2 emissions from anthropogenic sources was since observed in the middle of the 17^{th} Century, around 1750 (Richardson et al., 2009). The major sources were considered to be from transportation, urbanization processes, exhaust gasses of engines in urban centres, industrial processes, power plant, heating systems as well as change in land use (NEF 2010). These factors result in adversely affect and alters the climatic leading to public concerns which in turn led to the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 (Pires et al., 2011; I. E. A., 2011) and eventually led to the prompt calling for a meeting of the Inter-governmental Panel on Climate Change (IPCC) in 2001 (IPCC, 2005). These concerns were based on the most evident effects from Stringent climate changes causing destruction of ozone layer and global warming which led to oceans acidification, glaciers melting, sea level rise, climate perturbations, interference with wind velocity, as well as ecosystem destructions (Demaison and Moore, 1980; Houghton, 2001; Bastianoni, 2004; Sabineet al., 2004; IPCC, 2007) It is due to that that climate scientists have observed significant increase at which the rate of Carbon (IV) oxide is emitted into the atmosphere, despite the fact that they are considered to be the major greenhouse gas (GHG) amongst others, which is inconsistent with the world's energy generation from fossil fuel burning relied for more than 80% of its entire power generation (Van der Zwaan and Gerlagh, 2008; Benson and Surles, 2006; Steeneveldt et al. 2006; IEA, 2011).

Showing world primary energy supply

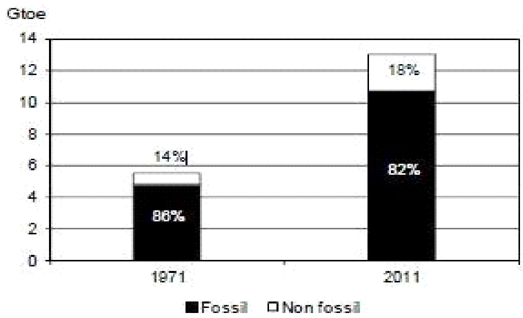

Figure1. *Showing world primary energy supply, Fossil fuels still accounts for most – over 80% of the world energy supply. (IEA, 2013)*

RESULTS

The Need for Geological CO_2 Storage

The magnitude of these effects suggest the need for technique (s) to address the global potential emission of CO_2. For instance European Union has called for developed countries to cutback discharges by 20% and 80% levels by from 1990-2020 in developed countries and 1990-2050 objective by the G-8 countries respectively (Rowling, 2009). As more significant cuts in CO_2 discharges continue being proposed within shorter time designations, various scientist dispute for utilization of a portfolio approach as the best method for reduction (Infocus, 2011). Although, this would include not only renewable energy sources (e.g. wind, biomass, hydrology, solar energy and energy), less carbon-intensive fuels (e.g. coal to natural gas), Nuclear Power, enhancement of biological sinks, can be instigated to alleviate the concentration of GHG emissions at commercial scale (IPCC, 2005; Infocus, 2011).

Recent advances in CO_2 mitigation technique have focus significantly on Carbon capture and storage (CCS), which is potential to stabilize the CO_2 concentration in the ambient air within (10-20 years), and probably would decrease the general expenses and expand adaptability in accomplishing greenhouse gas emanation decreases efficiently as shown in the fig. 2 (IEA 2005; IPCC, 2005; Benson and Surles, 2006; Pires et al., 2011). The figure shows that CO_2 captured by CCS was of 85-95% efficiency. Hence the need for geological CO_2 storage to reduce the ambient CO_2 concentration and possibly enhancement coal bed methane recovery (ECBM) (Reeves, 2005), enhanced oil recovery (EOR) (Klusman 2003; white, 2004; Wilson and Monea, 2004) see Fig. 3 or enhanced gas recovery (EGR) (van der Burgt et al. 1992). Considering the proven reservoirs fossil fuels are likely to remain main sources of primary energy for several decades a head (IEA, 2005).

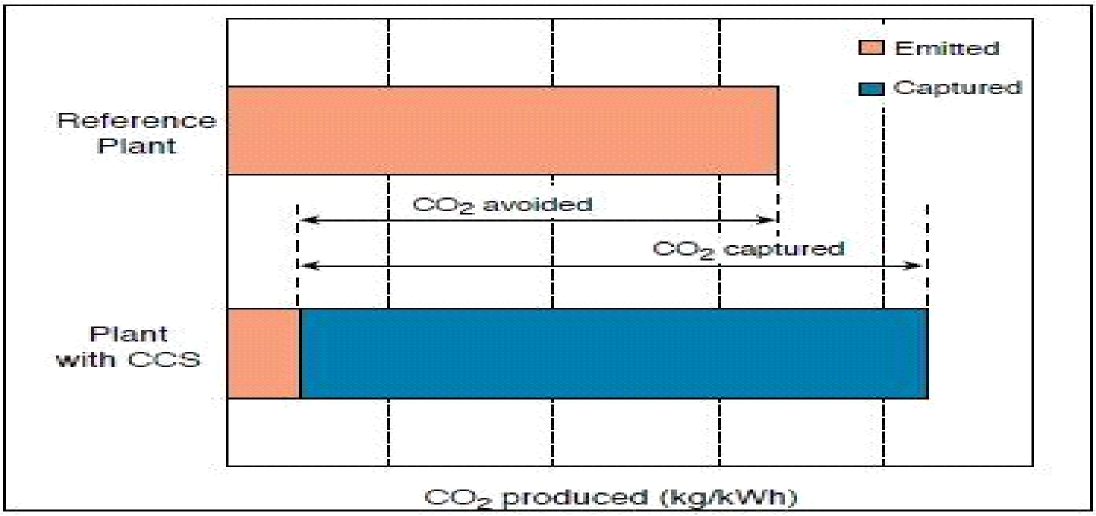

Figure2. *Showing the efficiency of Geological Carbon Capture Sorage from Power Plants. (IPCC, 2005)*

It is essential to note that, the capturing efficiency defends on the amount of CO_2 released during the Capturing process as well as other leakages.

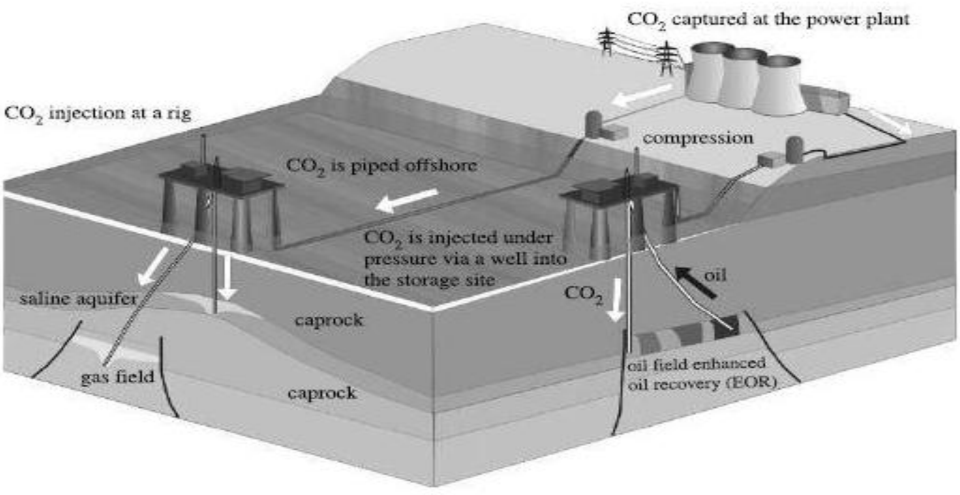

Figure3. *Showing an Overview of Geological Carbon Storage Options. (Holloway, 2007)*

Table1. *Comparative Benefits of Post Combustion, Precombustion, and Oxygen Combustion. (Benson and Surles, 2006)*

Technology	Advantages	Drawbacks
Post-Combustion	• Mature technology • Standard retrofit of existing power generation capability • Ability to bypass post-combustion capture allows plant to operate with its full original reliability and provide peaking power in excess of capture capacity	• High energy penalty lowers plant efficiency by ~30% • High cost compared to electricity production without CCS
Pre-Combustion	• Higher CO_2 concentrations lower the costs and energy penalties compared to post-combustion capture • Combine with H_2 production for transportation sector	• Gasification technology is immature for power production. • Repowering of existing capacity is needed • Large capital investment needed for repowering
Oxygen-Combustion	• Minimal post-combustion separation compared to air-fired power plants • Potentially higher generation efficiencies	• High cost of oxygen separation • High cost compared to electricity production without CCS

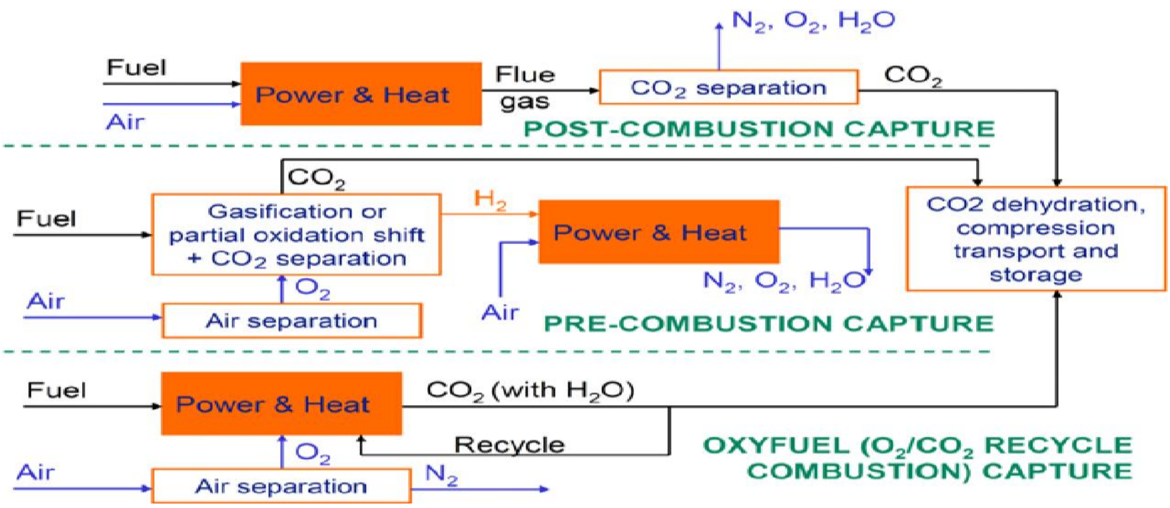

Figure4. *Principles of three main CO2 Capture options. (Jordal et al., 2004)*

As shown in the Fig 5, the process of CCS involves capturing, transporting and storage putting into account, that any leakages during both transporting and after storage will affect the efficiency of the process (IPCC, 2005; Holloway, 2007).

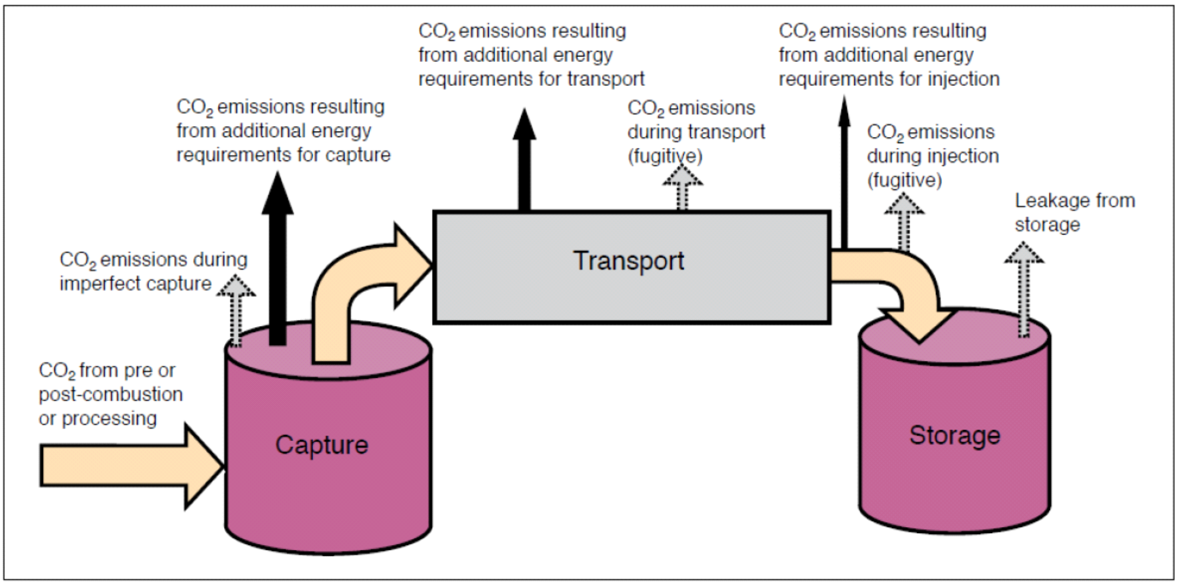

Figure5. *Efficiency Losses during Process Chain (ICCP, 2005)*

Hindrances to the Feasibility of CO_2 Storage

Although other methods of sequestering CO_2 such as high-temperature membranes and chemical looping, we are much more interested in discussing the Geological Carbon dioxide (CO_2) capture and storage (CCS) which serve as the best technology in separating CO_2 from point source emissions such as energy related sources (e.g. power plants), industrial and transport to an underground storage location e.g. saline aquifers, coal seams water-bearing reservoir rocks, deep saline formations or for industrial process usage mostly by the use of Pipelines, as shown in the fig. 3 (IPCC, 2005; Rubin et al. 2005; Holloway, 2007) that might have been released into the atmosphere. Different types of CCS exists which includes post combustion which is economically feasible used mostly in power plants and beset used commercially (Gibbins, 2008), pre-combustion which is more elaborate and costly widely used in fertilizer production and oxyfuel combustion that uses high purity oxygen but under demonstration phase, a more reasonable remunerations of the aforesaid are itemised in Table 1 and principles in Fig.4 (Jordal et al., 2004; Benson and Surles, 2006; Holloway 2007; Gibbins, 2008) and technique selection defends on the nature of fuel, CO_2 concentration and the pressure of the gas stream (IPCC, 2005).

Factors Affecting Geological CO_2 Capturing Storage

Based on ICCP (2005) the several factors affecting CCS are e.g. Health, safety, Environmental risks, Costs, Storage, and Public understanding amongst which are discussed. As shown in Fig.6, physical and pipeline leakage during transport and stored CO_2 compromise CCS, which are similar to that of hydrocarbon pipelines during drills due to improper usage of resources e.g. models and data interpretation. These causes leakage in oceans altering the chemistry of the environment, hence affecting the ecological system negatively. On land, aquifers might be at risk and CO_2 can as well be released into the atmosphere. Limited experience due to less geological CCS projects, which will help in unlocking and the uncertainties, bringing about the sub-geological legislation not yet been set as well as the uncertainties of enhancing or reducing the fossil fuel quality via CO_2 injection. Running CCS is highly expensive which increases with increase in fuel prices. Another is cross-border storage where the countries that capture CO_2 affect those that didn't.

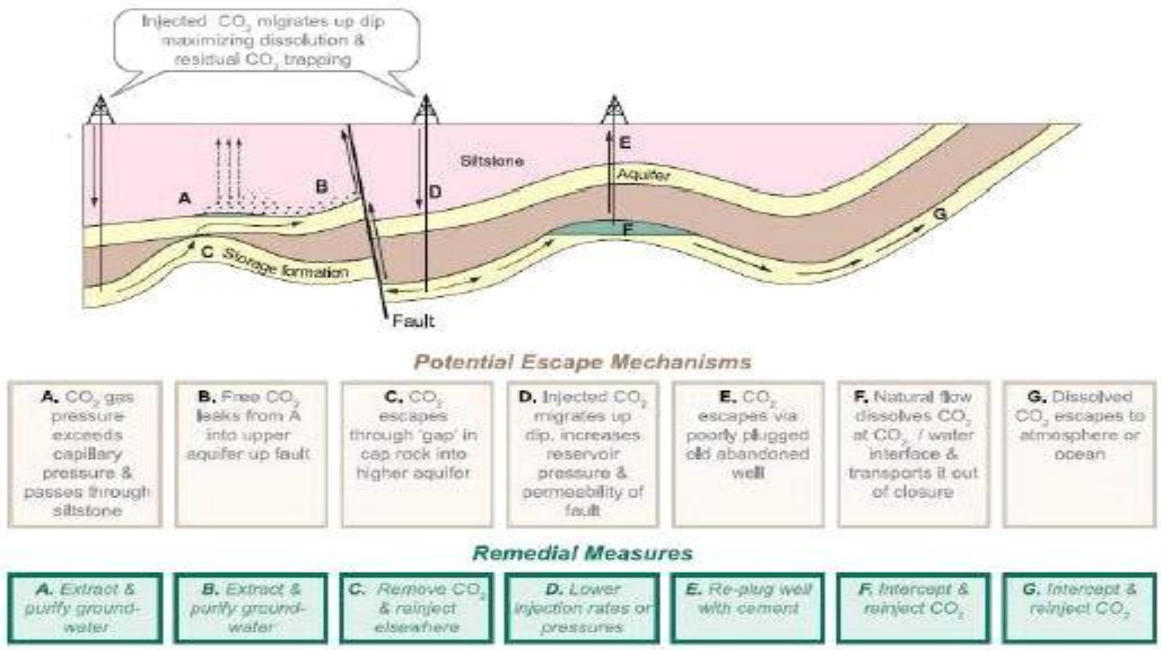

Figure6. *Potential Escape from Storage Site and Storage Safety (ICCP, 2005)*

Conclusion

Geological CCS is confirmed to be more than 80% efficient, which served as the best method to mitigate CO_2 emissions. Therefore, this can be accomplished by reducing the increase in CO_2 and other GHG in ambient air.

Recommendations

For Carbon IV oxide emission to be curtailed across the globe there has to be the intervention of both government and International developing and developed countries and donor agencies, to reduce the cost, boost the progress research as well as budget. For sure this will eventually generate certain results that could be used in setting legislation.

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